WIRE AND WIRE PRODUCTS

JUNE 1939

If it's **UNIFORMITY** you're looking for, try

REPUBLIC WIRE

Basic Open Hearth and Bessemer (Annealed, Regular, Hard Drawn, Sul Coated, Bright, Extra Bright, Copper Coated, Liquor Finish, Galvanized), Spring Wire, *Enduro Stainless Steel Wire, *Toncan Copper Molybdenum Wire, Cold Heading Wire, Wire Rods. Write for quotations. Republic Steel Corporation—Wire Division, 7850 So. Chicago Ave., Chicago, Ill.—General Offices, Cleveland, Ohio.

*Reg. U. S. Pat. Off.

REPUBLIC STEEL
REG. U. S. PAT. OFF.

STEEL AND TUBES, INC. • TRUSCON STEEL COMPANY
BERGER MANUFACTURING DIVISION
NILES STEEL PRODUCTS DIVISION
UNION DRAWN STEEL DIVISION

OFFICIAL PUBLICATION OF THE WIRE ASSOCIATION

● SAFETY
● FLEXIBILITY
● DURABILITY
● DEPENDABILITY

BUILT • IN FEATURES OF ALL

Vaughn

WIRE DRAWING EQUIPMENT

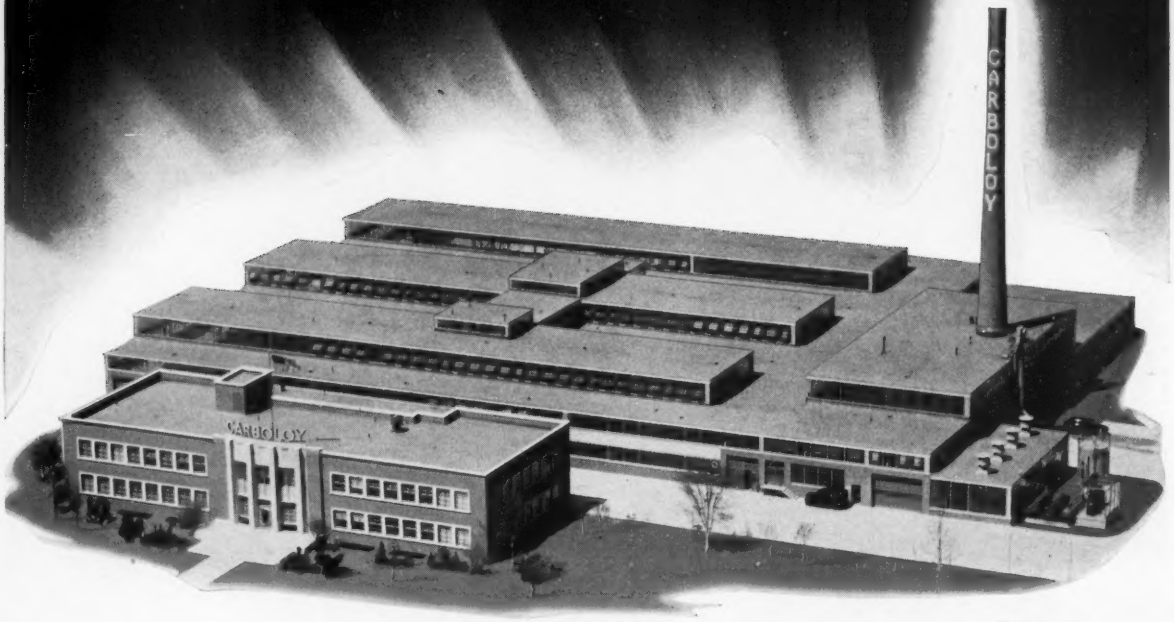
Every one of these features is indispensable to profitable operation.

Vaughn *Safety* (even aside from humane considerations) saves real money for you by lowered compensation costs—improved morale and man-efficiency. Vaughn *Flexibility* gives you the "change of pace" that enables better competition in today's markets. Vaughn *Durability* protects your investment by minimum upkeep needs and retarded depreciation. Vaughn *Dependability* assures uninterrupted high quality production on schedule—always.

Each of these qualities heads a separate chapter in the Vaughn story of Profits Today —without waiting for Tomorrow! Call a Vaughn Engineer for the facts.

THE VAUGHN MACHINERY CO.
CUYAHOGA FALLS, OHIO

ANNOUNCING



THE NEW FACTORY AND GENERAL OFFICES OF CARBOLOY COMPANY, INC.

We announce the opening of our new factory and general offices at Detroit, Michigan, combining all research, manufacturing and general administrative units formerly located at Cleveland, Detroit, and Stamford, Connecticut.

The Mark of CARBOLOY
REG. U. S. PAT. OFF.

These new facilities represent an investment made to meet certain requirements that we feel are vital to the sound growth of this industry. They provide for the development of a progressively higher order of economy—and initiate a program that should result in a more comprehensive use of cemented carbides throughout industry.

This new plant, embodying existing facilities for producing approximately 10 times the present amount of cemented carbide currently consumed by industry, with ample reserve space, is not only the *largest source of cemented carbide in this country*, it is a promise of far greater benefits to industry in the future than have been possible in the past.

CARBOLOY COMPANY, INC.

DETROIT, MICHIGAN

CHICAGO • CLEVELAND • PITTSBURGH • NEWARK • PHILADELPHIA • WORCESTER, MASS.

(A complete descriptive brochure available for executives on request.)

Photo courtesy Braeburn Alloy Steel Corporation, Braeburn, Pa.

Put Norton Research to Work

Cutting Billet Grinding Costs for You

A PRODUCT of modern research — that's a true description of Norton Resinoid Wheels for billet grinding. In the Norton laboratories there's a group of scientists that specializes in resinoid bond development. Not only have they made many important improvements in the bond formulae but have also developed an elaborate control system that improves production quality and uniformity.

These laboratory developments coupled with an entirely new production department with the very latest available equipment have resulted in new standards of quality for resinoid wheels — wheels that are cutting billet grinding costs for many mills. Let Norton engineers study your job and give you the benefit of these improved wheels.

NORTON COMPANY

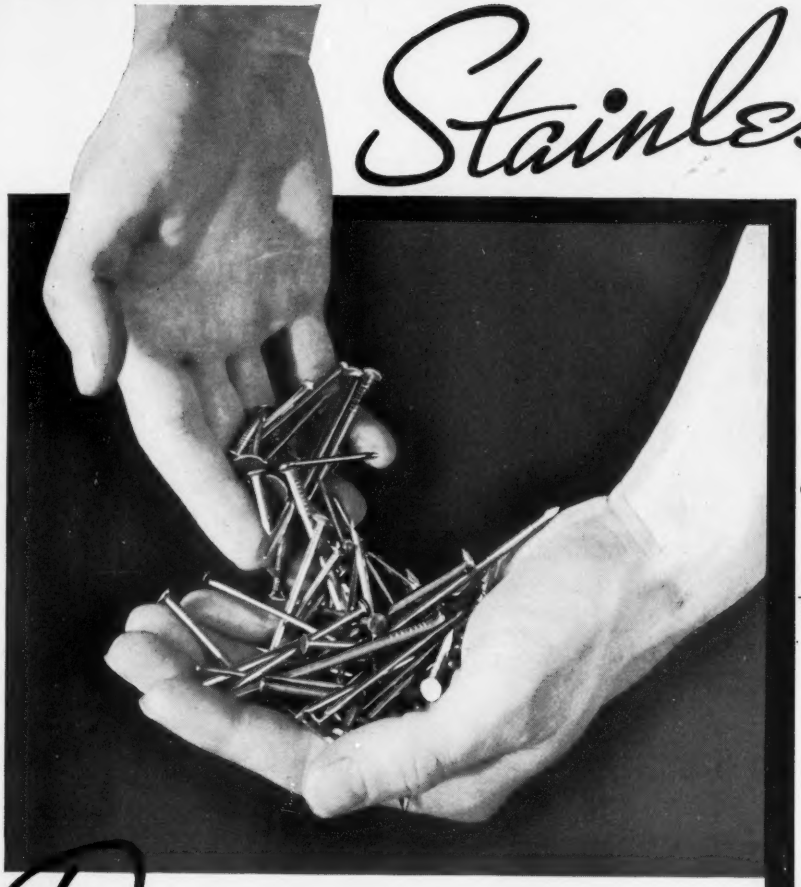
WORCESTER, MASS.

New York Chicago Detroit
Philadelphia Pittsburgh Hartford
Cleveland Hamilton, Ont.
London Paris Corsico, Italy
Wesseling, Germany
Behr-Manning Division, Troy, N. Y.

W-711

NORTON ABRASIVES

Stainless NAILS



Developed by **Pittsburgh**

FOR "101" APPLICATIONS

"Stainless" has given a new significance to *nails*. Almost daily new applications appear—needs for nails which are rust-proof, stain-proof, acid-resisting, or will serve under high temperatures. In the successful manufacture of these nails . . . as in the development of Stainless Steel Wire for many other fabricating purposes . . . we have brought to "stainless" 38 years of specialized wire manufacturing and fabricating experience, extensive research, and efficient craftsmanship. Put your wire problems up to "Pittsburgh," whether concerning carbon or stainless steel wires.

PITTSBURGH STEEL COMPANY · 1641 GRANT BUILDING, PITTSBURGH, PA.

Silos, Dairies, Refrigeration and Processing Equipment.

Attaching Rustless Gutters, Roofing, Siding, etc.

Boats, Docks, Mine Timbers, Filtration Plants, etc.

Pickling Vats, Acid Tanks, Dye Containers, High Temperature Furnace Insulation.

Pittsburgh Wires **P**

A COMPLETE LINE FOR ALL FABRICATING NEEDS

THE WIRE ASSOCIATION

WHAT IT GIVES YOU FOR $10.00 ANNUAL DUES

I. WIRE & WIRE PRODUCTS — For One Year.

The official publication of The Wire Association, covering the Wire Industry, its Metallurgy, Technology, Research, Processes, Machinery and Personnel.

Regular Subscription — $5.00 in U. S.
$7.50 Foreign.

II. THE ANNUAL BUYERS GUIDE AND YEAR BOOK OF THE WIRE ASSOCIATION.

A complete Directory of the Wire Industry, with alphabetical listings of its Products, Machinery and Raw Materials. Gives the source of all Supplies and Equipment used in both the Manufacture of Wire and Rod, and Wire Products produced therefrom.

The Year Book Section contains: Constitution and By-laws of The Wire Association; Details of year's meetings, etc; List of Members, Index to Papers and Articles in WIRE AND WIRE PRODUCTS.

Regular Sales Price — $5.00.

III. QUESTION AND ANSWER SERVICE.

This extremely valuable service to members answers Technical and Operating Problems both in WIRE AND WIRE PRODUCTS, and direct by mail if desired. Available to members without charge.

IV. ANNUAL CONVENTION AND EXHIBITION.

(In Association with American Society for Metals and The National Metal Congress.) Technical Sections, Plant Inspections.

V. REGIONAL MEETINGS.

Attendance at the Pittsburgh, Pa., Worcester, Mass. and New York meetings which include Local Plant Inspections, Technical Sessions and Discussions.

VI. PERSONAL CONTACTS.

Both at Annual and Regional Meetings, and throughout the year, for interchange of helpful information.

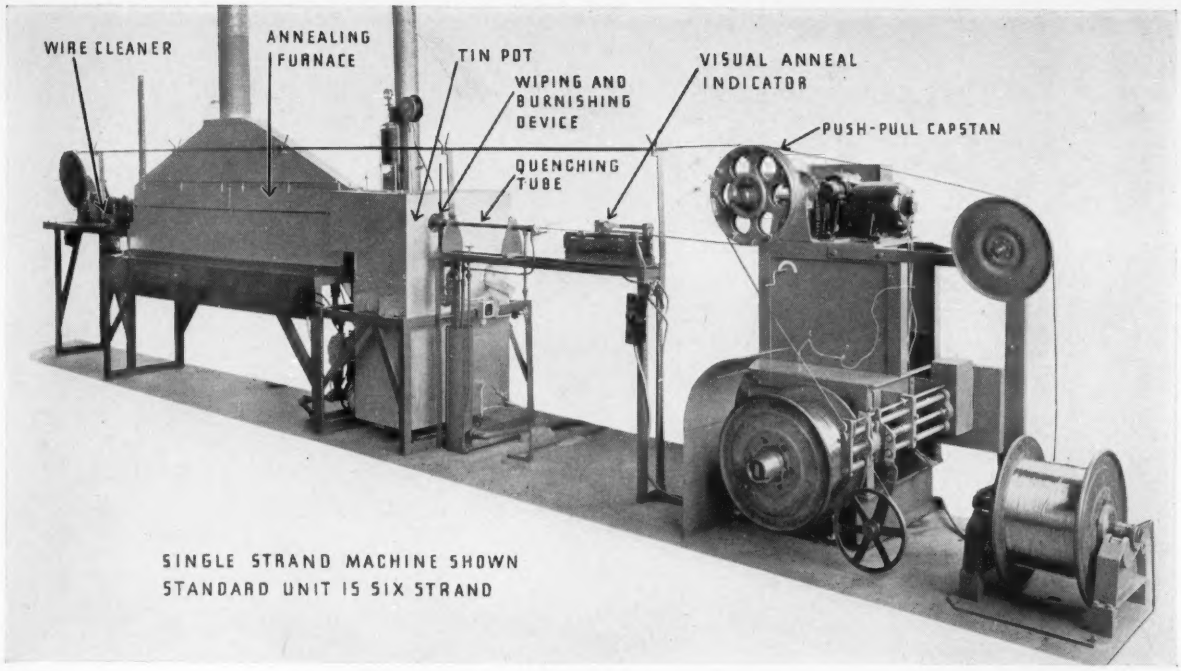
VII. INFORMATION SERVICE ON MACHINERY, EQUIPMENT AND SUPPLIES.

The Technical, Catalogue and Correspondence Files of the Wire Association hold the answer to practically every "Where can I buy" problem. This service is available to members without charge.

For Detailed Information Address

RICHARD E. BROWN,
EXECUTIVE SECRETARY

STAMFORD TRUST CO. BUILDING STAMFORD, CONN.



The annealing and tinning machine of tomorrow is here today!

• The Syncro Multiple Strand Annealing and Tinning Machine is one of the outstanding developments in the wire industry. It produces the highest quality annealed and tinned wire at the lowest possible cost per pound. The machine is extremely flexible and its operation is simple and conveniently controlled. A few of its interesting features follow.

• Each strand is equipped with a visual indicator, which constantly shows the degree of anneal occurring. This device makes possible extremely accurate and uniform control in obtaining the desired percentage of elongation.

• A push-pull capstan controls the wire line through furnace, assuring proper handling of the annealed wire.

• The annealing furnace is of the direct flame, gas fired type, providing efficient and properly controlled heating.

• The wire is passed through a chlorine fluxing agent prior to the application of tin. This flux is an extremely fast and thorough cleaning agent.

• Fluid tin is uniformly applied under pressure by means of a unique construction of jets. The tin is entirely enclosed, reducing oxidation losses to an absolute minimum. Excess tin is retrieved and the wire burnished to a high lustre as it leaves the tinning zone, by a self-cleaning wiping device of advanced design.

• Quenching takes place in circulating water and excess is removed by a highly efficient vacuum wiper.

• The take-up is motor driven and provided with a traverse. The spool drive automatically maintains correct tension throughout the filling of a spool. The spooling tension can be adjusted while machine is operating.

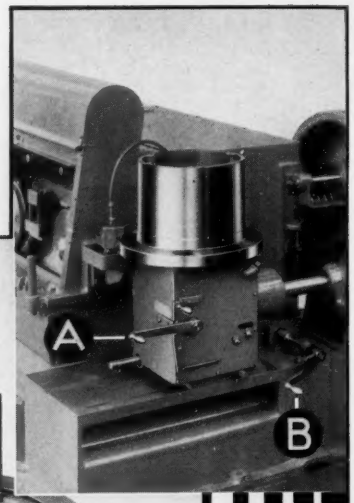
• Write for complete details and samples of wire finished by the remarkably fast, economical and efficient Syncro Annealing and Tinning machine.

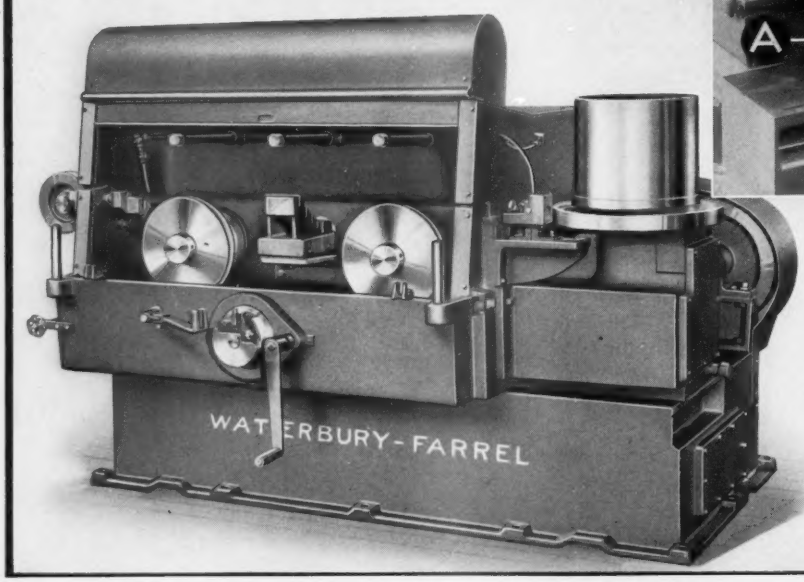
SYNCRO

SYNCRO · MACHINE · COMPANY

420 Lexington Avenue New York

WIRE DRAWING MACHINES





FOUNDED WATERBURY FARREL 1851

by WATERBURY-FARREL

WITH WIRE BLOCKS WHICH *rotate in either direction*

Upright Cone Continuous Machines with provision for quickly changing the rotation and position of block.
Two conveniently located removable handles do the trick in jig time—

A — changes direction of rotation
B — shifts position of block - - -

The machines are available with blocks of various diameters or with spooling devices. Our wire drawing machinery is described in Catalog W.

● WIRE AND ROD MACHINERY ● COLD HEADING MACHINERY, ETC. ●

WATERBURY FARREL
FOUNDRY & MACHINE COMPANY
WATERBURY • CONNECTICUT • U·S·A

Rod-and-wire Specialist...

Bethlehem engineers, who specialize in wire rods, forge close links between this company and the scores of manufacturers who work with Bethlehem rods. The experience of these men in their special field enables them to deal efficiently with every type of wire-rod problem from choice of analysis through the cleaning, patenting and drawing operations.

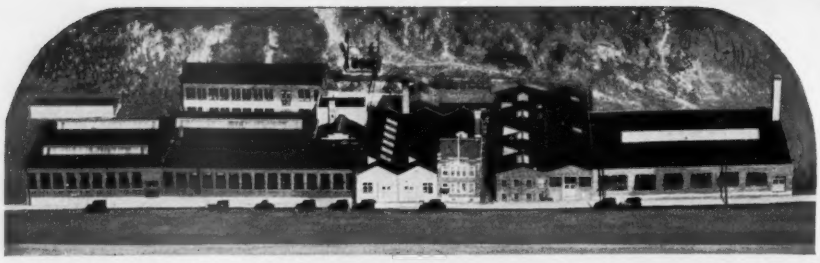
One of these men is at your service. His metallurgical and steel-making training gives him an advanced starting point from which to approach your particular problem. He is able to analyze the situation and make his recommendations with minimum delay. And he follows through each job until the kinks are ironed out and production running smoothly.

A letter or call to the nearest Bethlehem district office will bring quick response by a wire-rod specialist. His advice may prove profitable and helpful to you.

BETHLEHEM STEEL COMPANY

BETHLEHEM STEEL

HUDCO



HUDSON WIRE CO. PLANT AT OSSINING, N. Y.

This plant is one of the most modern and completely equipped plants in the world for the production of "HUDCO" fine wires in all metals

HUDCO

WIRES FOR METAL SPRAYING

Pure Lead, Lead Alloy, Pure Zinc, Zinc Alloy, Copper, Tin, High Brass, Low Brass, Solder Wire, High Conductivity, Electric Wire. Cadmium, Nickel Silver, (10%, 18%, 30%); Aluminum, Monel Metal, Phosphor Bronze, Pure Nickel, Commercial Bronze.

BRUSH WIRES, CRIMP AND STRAIGHT

Brass, Steel, Nickel Silver, Copper and Phosphor Bronze.

HUDCO

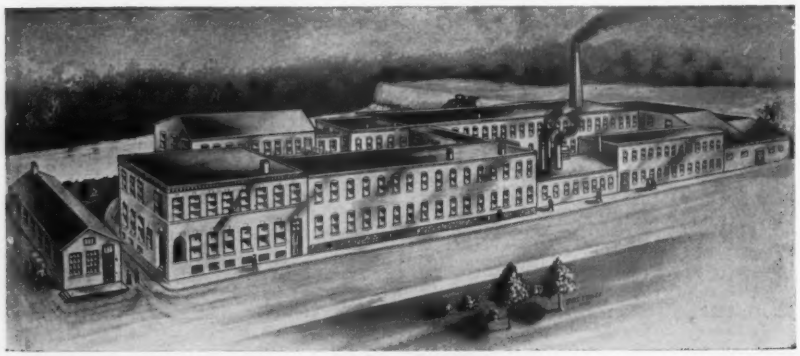
FINE BARE WIRES

High Brass, Low Brass, Zinc 99.99+ and High Tensile Zinc, Commercial Bronze, Phosphor Bronze, Pure Tin, Lead, Antimonial Lead, Tinsel Lahns, Silver Plated Copper, False Gold and Copper. Cadmium, Nickel Silver, 10%, 18% and 30%; Silver Plated Copper, False Gold and Special Brass and Bronze Alloys to Specification, Metallic Fibre for Packing Purposes, Copper, Bronze, Zinc, Lead and Aluminum.

"HUDCO" specially processed Copper Wire for enamelling purposes is drawn from Selected Copper, insuring the maximum conductivity. This is but one example of the use of the most advanced and approved materials and methods in our processing. BETTER WIRE AT LOWER COST.

SEND US YOUR SPECIFICATIONS AND LET US QUOTE PRICES.

HUDSON WIRE COMPANY OSSINING, N. Y.



Winsted Division of HUDSON WIRE CO. at Winsted Conn., modern and completely equipped enamelled wire plant for LEAKPROOF ENAMELLED WIRE and all standard and special coverings.

WINCO

"WINCO" enamelled wire is drawn from special selected copper, assuring perfect enamelling. All wire tested before shipment.

"WINCO" enamelled wire is available in all standard and special coverings made to meet exacting requirements.

Samples of LEAKPROOF and other enamelled wires sent on request.

WINSTED DIVISION OF HUDSON WIRE COMPANY

WINSTED, CONN.

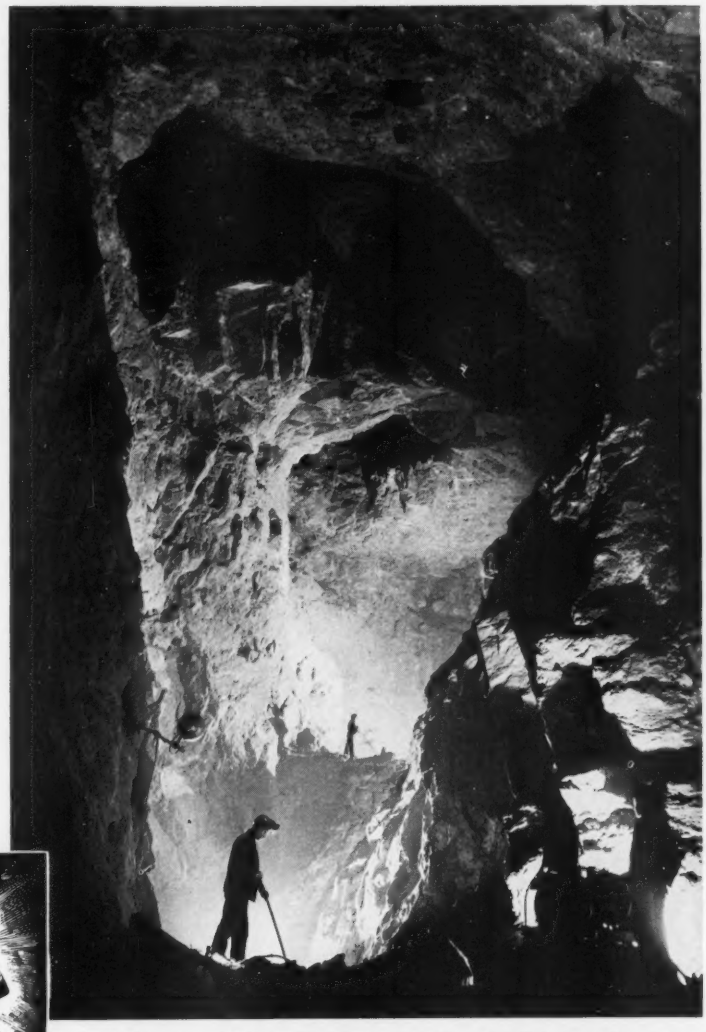
FROM ORE TO METAL

The Story of St. Joe Electro-Thermic Zinc—Number 2 of a Series

Man-made Caverns

THE limestone is so solid that no timbering is necessary. The veins have a dip of about 45 degrees. Distance from foot wall to hanging wall at places, is over 60 feet, and the man-made caverns left after blasting out 400,000 tons of rock a year grow to gigantic dimensions.

From these stopes the zinc in the ore starts its long journey, traveling by gravity to the underground chutes and ore pockets, eventually being converted into St. Joe electro-thermic zinc at the Josephtown, Pennsylvania, smelter of the St. Joseph Lead Company.



"Underground photograph of a stope in the Balmat Mine of the St. Joseph Lead Company in St. Lawrence County, New York State."

ST. JOSEPH LEAD COMPANY

250 PARK AVENUE • NEW YORK

ELdorado 5-3200

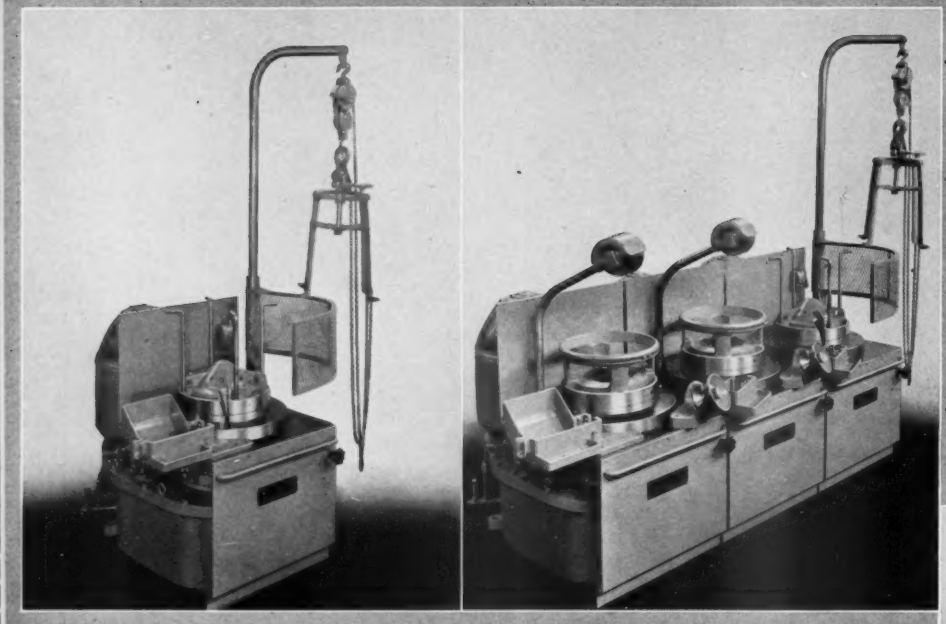
PLANT AND LABORATORY, JOSEPHTOWN, BEAVER COUNTY, PENNSYLVANIA

The AETNA WIRE DRAWING UNIT

PATENTS PENDING

ADAPTABLE for SINGLE DRAFT or MULTIPLE DRAFT CONTINUOUS DRAWING

Featuring ★ ★ ★ ★ ★ **UTILITY WITH MAXIMUM FLEXIBILITY**



★ **WIDE SPEED RANGE**

★ **POSITIVE SAFETY CONTROL**

★ **WATER-COOLED BLOCKS AND DIES**

★ **INDIVIDUALLY MOTORED BLOCKS**

COMBINATIONS---of Two or More 16", 22", or 26" Aetna Units are available for any continuous wire drawing requirement.

Superior Wire Quality is attainable on all Aetna-Standard Wire Machines at unusually **High Drawing Speeds** through effective **Water-Cooling.**

THE AETNA-STANDARD ENGINEERING COMPANY

CONSULTANTS—DESIGNERS AND BUILDERS TO THE STEEL AND NON-FERROUS INDUSTRIES

YOUNGSTOWN, · OHIO, · U. S. A.

ASSOCIATED COMPANIES

Head, Wrightson & Co. Limited, Thornaby-on-Tees, England. Aktiebolaget Arboga Mekaniska Verkstad, Arboga, Sweden.

WIRE AND WIRE PRODUCTS

A monthly publication devoted to the production of Wire, Rod and Strip, Wire and Rod Products and Insulated Wire and Cable

DRAWING—ROLLING—EXTRUDING—FORMING—FABRICATING

Vol. 14 JUNE, 1939 No. 6

Designated as

Official Publication By The Wire Association

Contents

Metallography in the Wire Industry ..... Prof. Carl G. Johnson 305
A paper presented at the Worcester Regional Meeting of the Wire Association describing the manifold uses of the miscroscope in wire production.

Problems in Wire Production and Use ..... G. A. Caldwell 311
An outline of some of the problems met in the manufacture of Tungsten filament wire, lead-in wires, spring and armature banding wire and copper wire at the Westinghouse Electric & Mfg. Co. plant.

Norton Co. Plant Inspection by Wire Association 316

The Carbide Die - History, Manufacture and Use ..... Dr. E. W. Engle 319
A study of the development of the carbide die, the present method of manufacture, and of the many diversified uses for dies and tools in general industry.

Pittsburgh Regional Meeting and Visit of Wire Association to Plant of Westinghouse Electric & Manufacturing Co. 325

Carboloy Company Opens New Plant at Detroit 328

Exports and Imports of Wire 334

'Round the World with the Wire Industry 341

A Review of Recent Wire Patents 343

Index to Advertisers 353

Where to Buy 354-356

—ASSOCIATE EDITORS—

Kenneth B. Lewis, Consulting Wire Mill Engineer
W. H. Spowers, Jr., Consultant on Galvanizing
Lancaster, Allwine & Rommel, Consultants on Patent Information
European Correspondent
Paul Fidrmuc

Richard E. Brown, General Manager
R. S. Spengel, Business Manager
Edwin M. Dixon, Advertising Manager

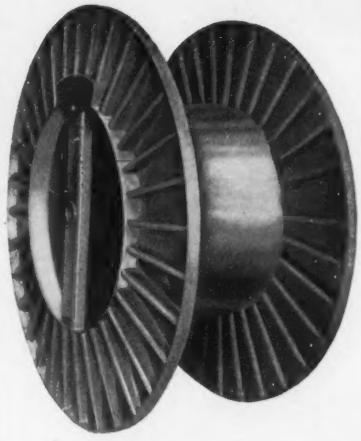
Publication Office: Washington, N. J.
Executive Office: Stamford Trust Co. Bldg., 300 Main St., Stamford, Conn.
Annual Subscription, U. S. $5.00, Canada $5.00

50 Cents a Copy Issued Monthly Foreign, $7.50

Copyright 1939, Quinn-Brown Publishing Corp. WIRE AND WIRE PRODUCTS is fully protected by copyright and nothing that appears in it may be reprinted wholly or in part without permission.

WIRE & WIRE PRODUCTS, Vol. 14, No. 6, June, 1939, Executive Office, 300 Main St., Stamford, Conn. Published by the Quinn-Brown Publishing Corp., Richard E. Brown, President; R. S. Spengel, Secretary and Treasurer. Publication office, 13 West Church Street, Washington, N. J. Subscription price: U. S., $5.00; Canada, $5.00 per year, 50 cents per copy; Foreign, $7.50 per year. Entered as second class mail at the Post Office, Washington, N. J., under Act of March, 1879.

FOR REEL ECONOMY



STEVENS
LOW-TARE
STEEL SHIPPING REELS

AND

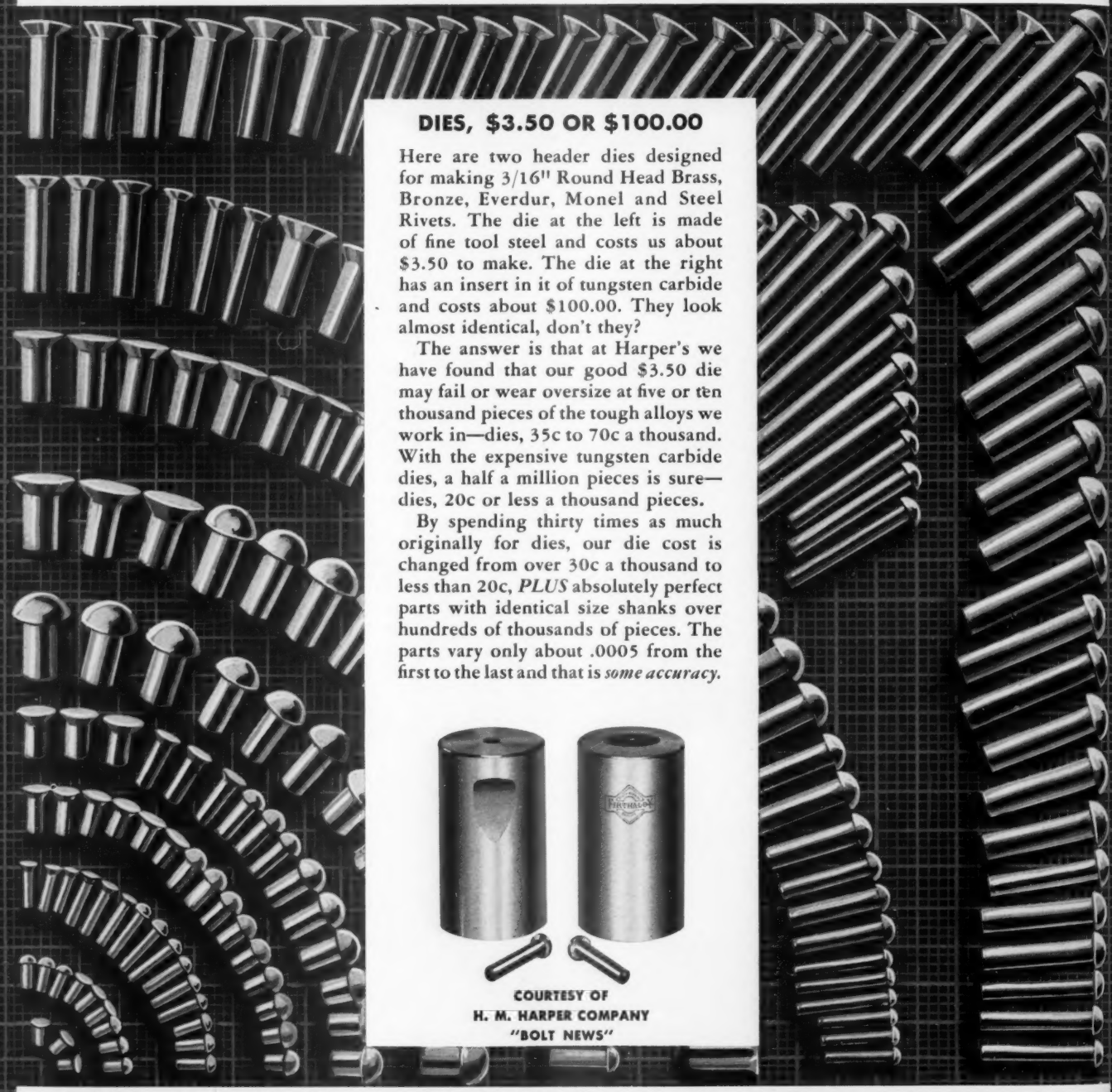
STEVENS FLANGED STEEL DRUMS

LOW-WEIGHT
PLUS
LONG LIFE

MADE IN IPCEA AND SPECIAL SIZES
COMPLETE DATA & PRICES UPON REQUEST

THE STEVENS METAL PRODUCTS CO.
NILES, OHIO

DO YOUR DIES COST $3.50 OR $100.00?



DIES, $3.50 OR $100.00

Here are two header dies designed for making 3/16" Round Head Brass, Bronze, Everdur, Monel and Steel Rivets. The die at the left is made of fine tool steel and costs us about $3.50 to make. The die at the right has an insert in it of tungsten carbide and costs about $100.00. They look almost identical, don't they?

The answer is that at Harper's we have found that our good $3.50 die may fail or wear oversize at five or ten thousand pieces of the tough alloys we work in—dies, 35c to 70c a thousand. With the expensive tungsten carbide dies, a half a million pieces is sure—dies, 20c or less a thousand pieces.

By spending thirty times as much originally for dies, our die cost is changed from over 30c a thousand to less than 20c, *PLUS* absolutely perfect parts with identical size shanks over hundreds of thousands of pieces. The parts vary only about .0005 from the first to the last and that is *some accuracy.*

COURTESY OF
H. M. HARPER COMPANY
"BOLT NEWS"

Initial cost may be high but FIRTHALOY Dies are the cheapest in the long run.

FIRTH-STERLING STEEL COMPANY

Works: McKEESPORT, PA.
NEW YORK CHICAGO
HARTFORD PHILADELPHIA
LOS ANGELES DETROIT
CLEVELAND DAYTON
GLOBE WIRE DIVISION
McKEESPORT, PA.

WIRE AND WIRE PRODUCTS

A monthly publication devoted to the production of Wire, Rod and Strip.
Wire Products and Insulated Wire and Cable.
DRAWING --- ROLLING --- EXTRUDING --- FORMING --- FABRICATING

Vol. 14 JUNE, 1939 No. 6

Metallography In The Wire Industry

By Carl G. Johnson,
Assistant Professor.
Worcester Polytechnic Institute, Worcester, Mass.

A paper presented at the Worcester Regional Meeting of the Wire Association held at Worcester, Mass., April 25, 1939 describing the manifold uses of the microscope in wire production. ✦ ✦ ✦ ✦ ✦

Introduction

THOSE who read this paper in anticipation of obtaining information of new methods or new disclosures resulting from the use of the microscope in the study of wire will be disappointed. This article deals only with the more or less routine microscopic studies that are being used in the wire industry, thus making this article elementary, and of interest to those who are not very familiar with the microscope.

✦ ✦ ✦

IT might interest the reader to know that the use of the microscope in the study of metals is less than 100 years old, having been started in 1864 by Sorby, an English scientist. Since **Sorby's** early work in the field of metallography rapid strides have been made in the development of metallographic technique, and, more important, in the correlation of the structural nature, as revealed by the microscope, with that of the physical behavior of the metal. Although the microscope has been the most valuable tool developed for structural studies of the metals and has contributed much to our knowledge, yet we have much to learn about the real nature of the metals.

PROFESSOR CARL G. JOHNSON
Born and raised in Worcester, Mass. Associated with the Worcester Polytechnic Institute since 1921. Has spent most of the time in the field of teaching although working on industrial problems. Lecturer at the Vocational Summer School, Fitchburg State Teachers College. Instructor in Evening School of the Worcester Junior College. Conducts evening classes in Metallurgy at the Worcester Polytechnic Institute. Associated with the Massachusetts Steel Treating Corp. as consultant. Author of text books on Forging Practice and Metallurgy. Past Chairman and present Sec'y.-Treas. of the Worcester Chapter of the American Society for Metals. Member since 1921. Vice President of the Worcester Engineering Society.

A GREAT deal remains to be done in the field of metallography before our knowledge becomes complete enough so that we can answer many of the common problems that arise concerning the behavior of the metals. Perhaps in an effort to learn something about the real nature of the metals and to obtain answers to our many problems new technique and methods of study will be developed which will replace our present technique and even the microscope.

✦ ✦ ✦

The Common Constituents Of Wire

THE identity of the common constituents that may be found in steel wire is well established, but as the article is championed as an elementary one, we will consider the more common constituents briefly.

✦ ✦ ✦

THE common constituents that may be found in steel are: ferrite, pearlite, cementite, martensite, sulphides, and oxides. The

following illustrations indicate the appearance of these constituents as seen with the aid of the microscope. The properties of any steel wire may be largely influenced by these constituents. Briefly, the influencing effects of each of these constituents may be indicated as follows:—

✦ ✦ ✦

FERRITE, illustrated in Fig. 1, is soft and very plastic, and it is ferrite that makes possible any cold working of steel, such as wire drawing. We might consider ferrite as the plastic phase.

✦ ✦ ✦

CEMENTITE is a hard, brittle compound of iron and carbon and may be considered as the hardener in steel. It makes steel hard and increases the difficulty of cold working. It is very important to control the amount of cementite in steel and also to control the way it becomes distributed and the size and shape of the particles of cementite. We might consider cementite as a brittle phase. Cementite is a constituent of pearlite, illustrated in Fig. 2, and forms a white network in Fig. 20.

✦ ✦ ✦

PEARLITE, illustrated in Fig. 2, is a mixture of ferrite and cementite. Pearlite may be considered as being composed of ferrite in which particles of cementite are buried. The cementite, being hard and brittle, leaves the pearlite hard and much less plastic than ferrite without the presence of cementite. The properties of pearlite may be greatly varied by changing the size, shape, and distribution of the cementite. This may be accomplished by heat treatments and cold working.

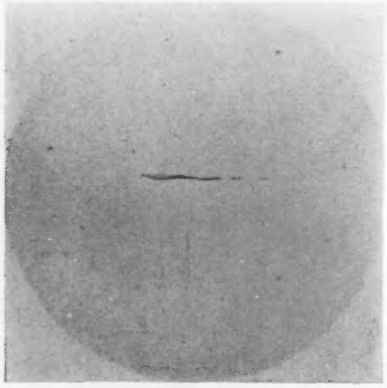


Fig. 4. Manganese-Sulphide. Mag. 100 X. (Steel Wire). ✦ ✦ ✦ ✦

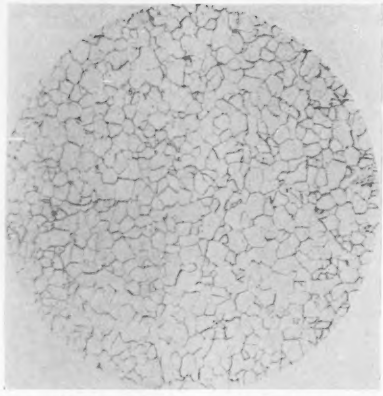


Fig. 1. Ferrite at 100 X. (Low Carbon Steel) ✦

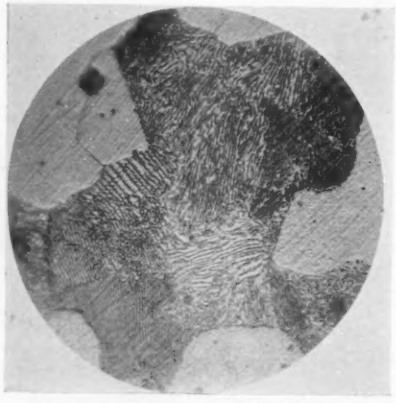


Fig. 2. Pearlite in Ferrite mag. 1,000 X. (Medium Carbon Steel). ✦ ✦ ✦

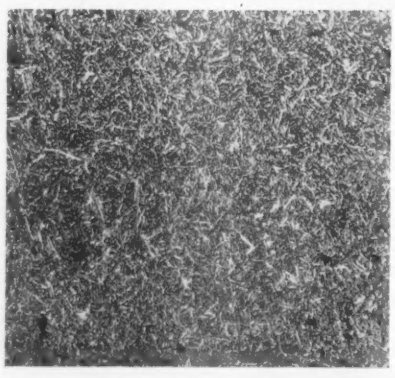


Fig. 3. Martensite at 500 X. Oil Quenched Wire Not Tempered. ✦ ✦ ✦

✦ ✦ ✦

MARTENSITE is a structure obtained only after severely quenching from high temperatures steels that contain considerable cementite. This treatment results in a solution of the cementite in the ferrite, leaving a hard and brittle state. This structure called "Martensite," illustrated in Fig. 3, is never used in wire, but in the treatment for tempered wire the wire is often made martensitic in structure and then reheated to allow martensite to change to a fine aggregate of ferrite and cementite. The resultant structure, a fine pearlite, is strong and tough.

✦ ✦ ✦

MANGANESE sulphide is a common constituent of steel. Its influencing effects in wire are not very well understood and, from results of all the tests that have been carried on to determine the effect of manganese sulphide, we might assume it is not a very important constituent. Fig. 4 shows MnS in longitudinal section of wire.

✦ ✦ ✦

OXIDES may in general be considered as a menace to good steel, particularly in "spring tempers" with its much higher yield strength. However, nothing very definite in the way of failures can be chalked up against oxides. The general attitude towards them is that they may act as stress raisers and therefore may be the source of early failure. Fig. 5 illustrates appearance of oxides that may be found in steel.

✦ ✦ ✦

Structural Effects of Cold Working and Annealing

THE microscope may be used in the study of the structural changes occurring during cold working and annealing, but it does

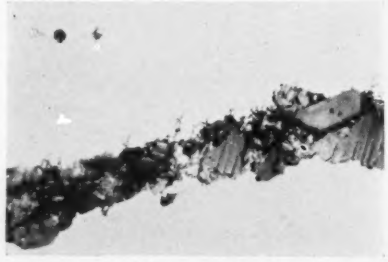


Fig. 5. Oxicles Magnified 1,000 X. ✦

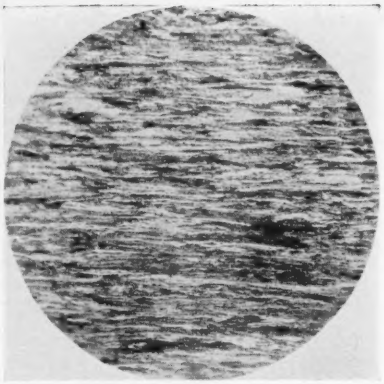


Fig. 6. Hard Drawn Music Wire 500 X.

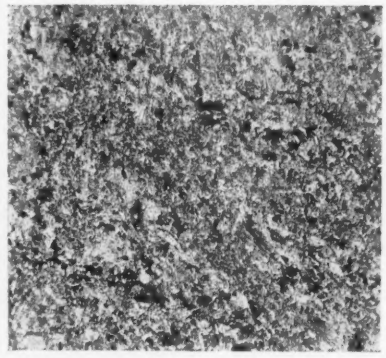


Fig. 9. Fully Recrystallized.

Fig. 7 to 11 Inclusive are of Cartridge Brass. Magnified 100 Times.

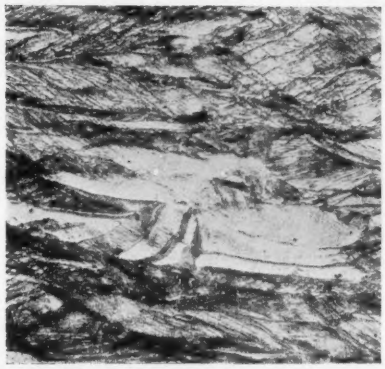


Fig. 7. Cold Worked.

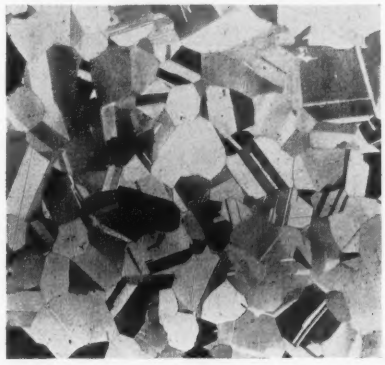


Fig. 10. Annealed 1200° F.

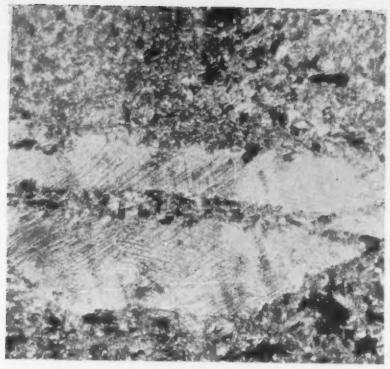


Fig. 8. Partly Recrystallized.

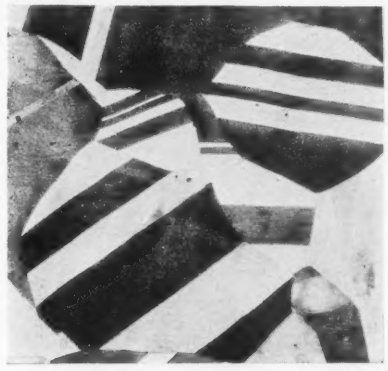


Fig. 11. Annealed 1450°F.

not serve to explain the marked changes in properties that accompany these structural changes. We are all familiar with the increase in strength and hardness that accompanies cold working. The microscope only reveals a grain distortion as shown in Fig. 6 and does not explain why this distorted grain differs from the annealed grain. Also in annealing the microscope reveals that the cold worked and distorted crystals are reborn (recrystallized) into new and, at first, very tiny crystals and on further heating these crystals absorb one another, causing a decrease in the number of grains and therefore an increase in their average size (grain growth). This study with the microscope gives the metal worker some knowledge of changes occurring and offers some explanation for the changes he is trying to effect. Fig. 8 illustrates cold worked metal that has been partially recrystallized by heating. Fig. 9 illustrates cold worked metal that has been completely recrystallized. Figs. 10 and 11 show results of further heating with its attendant grain growth.

✦ ✦ ✦

COLD working of an aggregate structure made up of hard and soft areas, such as are found in steel, may result in a very non-uniform flow of the structure. A coarse laminated pearlite structure or a structure made up of coarse pearlite and ferrite may produce a very poor flow of the grain structure during cold drawing. This type of structure may result in failure during drawing (cuppy wire) or may result in an apparent brittle state after being hard drawn. This brittle condition is caused by the non-uniform flow which results in certain areas becoming overworked as compared to other areas that resist plastic flow. The areas that undergo most of the deformation become severely work hardened. Non-uniform flow of a coarse aggregate structure is characterized by a wavy distorted structure. Such a structure is illustrated in Fig. 12.

Fig. 12. Defective Cold Drawn Wire 500 X. Non-uniform flow due to Coarse Pearlite.

✦ ✦ ✦

Inclusions in Wire

MENTION has already been made of oxides and sulphides in steel and any discussion of metallographic studies of wire is not complete without some ob-

servations of their effects. However, little can be added to what has already been pointed out and we might assume that any wire relatively free from dirt will make the best product. If it could be clearly evaluated, no doubt, we would find that inclusions affect the workability, heat treatments, and ultimate physical and chemical properties. No doubt you all have your own opinions as to this. Inclusions become very apparent with the aid of the microscope as illustrated in Figs. 13 and 14.

✦ ✦ ✦

OXYGEN is soluble in iron and perhaps the presence of oxides indicates considerable dissolved oxygen present in steel wire. Although not much attention has been paid to dissolved oxygen by the wire maker, its presence may be a serious factor affecting properties of wire.

✦ ✦ ✦

FIG. 13 illustrates oxides found in steel surrounded by areas of ferrite in which free or massive cementite may be often found. We might expect rather poor working characteristics with wire containing structures of this type.

✦ ✦ ✦

Bad Surface

A MICROSCOPE is not needed to illustrate bad surface on wire, however it may be used to magnify surface conditions as indicated in Fig. 15, where surface checks are also apparent and in very fine wire sizes it may prove valuable. Effects of bad surface may be very obvious where a high degree of finish is required for a saleable product. This may be illustrated in Fig. 16 where pitting of surface caused rejection of needles. This pitting was caused by scale forming during hardening operation and was not the fault of the wire maker. Bad surfaces on wire may be the cause of trouble and failure due to notch sensitivity. Surface seams are considered an ever present menace to the high quality of wire and wire products. A bad condition of a surface seam is illustrated in Fig. 17. This condition resulted in a fatigue crack. Surface conditions, acting as stress raisers, may serve as the source of early cracks. Bad surface should be guarded against in highly stressed tempered wire, particularly if this wire is to be subjected to plating where a brittle surface condition may exist. A classical example of failure contributed to by bad surface is indicated in an exhaustive study made by the Bureau of Standards regarding the cause of failure of wire used in the cable of the **Mt. Hope Bridge** at Providence, R. I., and the **Ambassador Bridge** at Detroit, Mich. The wire that failed was a heat treated wire which was hot galvanized. The report by the Bureau points out that occasional cracks were found along the surface of the wire. These cracks extended in rather deep and had very sharp ends which were filled with the brittle FeZn alloy formed from the hot galvanizing treatment. Tests of this wire resulted in very low ductility values (±3%) whereas, when the bad surface was removed, values as high as 53% elongation were obtained. The wire in the bridges failed by fatigue, and fatigue tests made on wire in the absence of the brittle FeZn alloy layer proved that such wire should have sufficient fatigue strength. Cold drawn wire, with a good surface due to finish produced by the drawing operation, was hot galvanized and did not fail in these tests. This would seem to prove that the primary cause of failure of the bridge wires was due to the FeZn alloy filling the rough surface of the heat treated wire.

Fig. 13. Oxides and Effects in Steel. 200 X. ✦

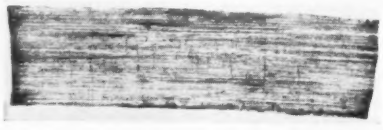


Fig. 15. Surface Cracks in Wire with Rough Surface. ✦ ✦ ✦ ✦

Fig. 14. Oxicles Causing Seams and Perhaps Cracks. Magnified 100 X. ✦ ✦

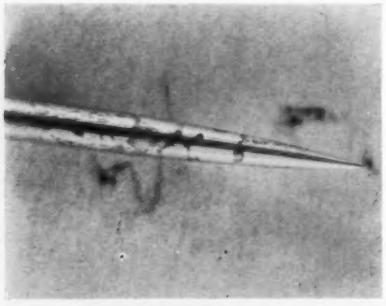


Fig. 16. Rough Surface Caused by Scale Forming during Heat Treating. ✦ ✦

✦ ✦ ✦

Decarburizing

A LOSS in the carbon content of the surface of steel known as **"decarburizing"** is one of the most

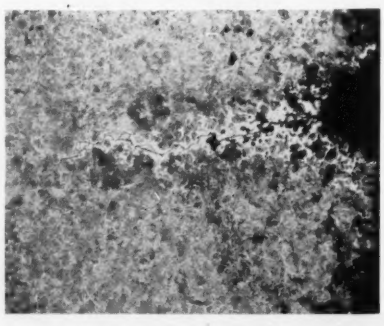


Fig. 17. Surface Seam Caused the Formation of Fatigue Crack in Spring Wire. Magnified 200 X.

common defects found in steel wire. This loss in carbon is due to oxidation during any heating or cooling cycle unless precaution is taken to avoid presence of an ozidizing atmosphere. Hot rolled rods always have a decarburized zone which may vary from a trace to 0.060 inches. Cold drawn wire made from a rod with a decarburized zone will naturally have a decarburized surface. However, a rod with a very slight decarburized zone may have this reduced by the combined effects of acid cleaning, cold drawing, and heat treatments. On the other hand the decarburized zone may be increased by decarburizing during some normalizing or annealing heat treatment. Decarburization is easily determined with the microscope and is illustrated in Fig. 18.

✦ ✦ ✦

WE may classify **decarburization** as a defect and assume that it may be a source of failure and rejections in wire, particularly in the higher carbon grades that are used in the tempered condition. Wire articles that require a high surface hardness after heat treating will suffer from any decarburized surface. It is recommended that decarburization be kept to a minimum in tempered spring wire. It has been reported that a decarburized surface on tempered coil springs, such as are used in the modern automobile, is a source of fatigue failure. The decarburized zone with its lower fatigue strength is considered a source for the beginning of fatigue cracks.

✦ ✦ ✦

Grain Size

MUCH has been said and written concerning "grain size," both so-called "inherent" grain size and so-called "actual" grain size. Much more investigation and keen observation on the part of the wire maker is needed before we clearly understand just what it is all about. (The grain size referred to is the grain size developed by the austenitic structure at whatever temperature the wire is heated to during the heat treating cycle.) In general an inherent fine grained steel will develop a fine grain size in the austenitic range, whereas a coarse grain steel will develop a coarse grained austenitic structure. The effect of the inherent grain size of the steel depends a great deal on the maximum temperature to which the steel becomes heated. The maximum grain size developed depends upon the grain growth ability of the austenitic structure and this is influenced greatly by the maximum temperature.

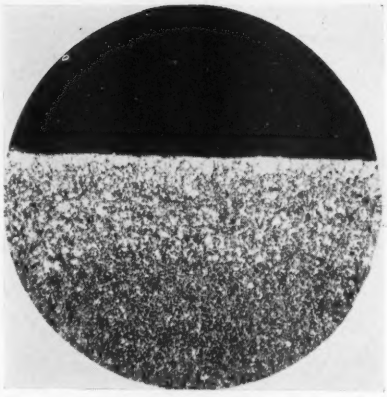


Fig. 18. Decarburization in High Carbon Wire. Magnified 100 X. ✦ ✦ ✦

✦ ✦ ✦

OUR methods of determining grain size have been more or less explored and the general opinion at present is to measure the grain size obtained from a given standard heat treatment of the material under observation. This involves heating the steel wire to within the temperature range used in actual practice and then subjecting the steel to some selected cooling rate that may aid in measuring the size of the developed austenitic grain. Quenching the steel wire from the maximum temperatures in oil as in oil tempering, followed by special metallographic technique, may be successfully used to bring out the austenitic grain size.

✦ ✦ ✦

QUENCHING so as to bring out the austenitic grain size is illustrated in Fig. 19 where the old austenitic grain size is indicated by being outlined by the formation of primary troostite. Etching so as to bring out the outlines of the austenitic grain size in a martensitic structure is shown in Fig. 24. The MacQuaid-Ehn method of carburizing steel wire at 1700° F., followed by a slow cooling with the precipitation of carbide outlining the original austenitic grain size, is illustrated in Fig. 20. This practice is often frowned upon because of the temperatures used in an active carburizing atmosphere which may not indicate the grain growth character of the same steel wire at other temperatures than the one used in the test.

✦ ✦ ✦

EFFECTS of coarse versus fine grained steel as used in wire making need much enlightening. In general it is indicated that relatively fine grain size wire is recommended for wire that is to be given heat treatments, whereas coarse grained steel may be most successfully cold drawn.

(*Please turn to Page 348*)

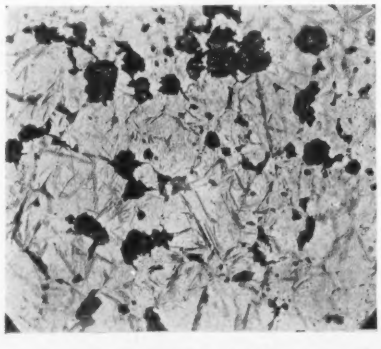


Fig. 19. Primary Troostite in Martensite. The Primary Troostite forming first on Quenching forms at the grain boundaries of the Original Austenite and may be used to outline the original Austenitic grain. Magnified 500 X. ✦

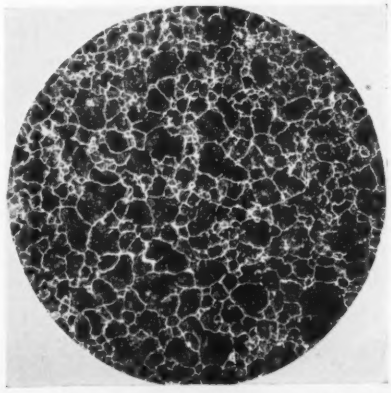


Fig. 20. Carburized Steel Wire for MacQuaid-Ehn Method of Grain Size Determination. Mag. 100 X. ✦ ✦ ✦ ✦

The ANNUAL MEDAL AWARD OF THE WIRE ASSOCIATION

For the Most Meritorious Paper on
Wire Manufacture or Fabrication During the Year

ALL members of the Wire Association are cordially invited to submit technical papers either for publication in "WIRE & WIRE PRODUCTS" during the year or for presentation before the Annual Wire Association Meeting at Chicago, October 23-27, 1939.

+ + +

FOR 1939 and subsequent years a medal will be awarded in each of the two major divisions of the activities of the Association, to the papers coming nearest to the requirement set forth above.

+ + +

CONSIDERATION for the Medal Awards is not limited to the papers presented at the Annual Meeting, but is given to all papers submitted by members and published in "WIRE & WIRE PRODUCTS" during the year.

+ + +

SELECTION of papers to be presented at the Annual Convention rests in the hands of the Joint Programme Committee of the Wire Association.

+ + +

ALL papers submitted become the property of the Wire Association, and the Board of Directors constitutes the Committee on Awards.

+ + +

ADDITIONAL information may be obtained by addressing:

RICHARD E. BROWN,
SECRETARY, THE WIRE ASSOCIATION

Stamford Trust Co. Bldg., STAMFORD, CONNECTICUT

Problems In Wire Production and Use

By G. A. Caldwell,

Steel Mill & Metal Working Sec. Engineer,
Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa.

An outline of some of the problems met in the manufacture of Tungsten filament wire, lead-in wires, spring and armature banding wire and copper wire at the Westinghouse Electric & Mfg. Co. plant at E. Pittsburgh, Pa. A paper presented before the Pittsburgh meeting of the Wire Association, May 5, 1939. ✦ ✦ ✦

THE word "wire" is certainly well known and widely used. It may cause you to think of the fence around your yard or the electric wiring in your home. It is one of those items to which everyone is accustomed and accepted as a useful but uninteresting product. Few people not directly concerned realize the extreme range of its use or its importance in industry. The fact that there is a Wire Association made up of men whose life work centers around wire indicates that there are many technical problems to be solved and that many new developments may be expected in the future.

✦ ✦ ✦

PROBABLY the electrical industry has made as many demands for new types of wire as any other industry. Many of the demands are difficult to meet. On the other hand, the industry uses large quantities of standard wire with no unusual characteristics. Wire is the means of conducting current in practically all electrical machinery and the requirements of the wire are as varied as the machine itself. In some applications, the wire is used for mechanical purposes only, which again demands a different set of characteristics. The wire may be the ordinary copper wire used in an induction motor with its coating of enamel and paper for insulation, or the insulated wire on the back of a switchboard or control panel of which we use several million pounds annually.

✦ ✦ ✦

ON the other hand, it may be the Tungsten wire used in the incandescent lamps or the small wire inside the cable of an X-ray machine which must be insulated so that it can be handled with safety although the voltage on the wire is 110,000 volts. In these later applications the amount of wire is small, but it is the vital part of the equipment and so is very important.

✦ ✦ ✦

G. A. CALDWELL, Engineer

Steel Mill & Metal Working Section, Westinghouse Electric & Manufacturing Co., East Pittsburgh, Pa. Graduated from Purdue University, 1927, degree of Bachelor of Science in Electrical Engineering and entered service of Westinghouse Electric & Mfg. Co., in student course. Upon completion of course went to Control Engineering Department for one year at end of which was transferred to Application Department working in the development of electrical equipment for wire drawing machinery, for sheet mills and auxiliary drives for continuous hot strip mills.

Wire in Meters

IN the manufacture of meters, the precision of manufacture is comparable to a high grade watch. The spiral control springs that return the pointer to zero are made in a large variety of sizes, the smallest using a flat ribbon of wire with a thickness less than one-half thousandths of an inch and which develops a torque of .024 millimeter grams. Most of these springs are made from round phosphor bronze wire and are rolled in our factory to a flat ribbon.

✦ ✦ ✦

THE pivots which operate in sapphire cups are made from special wire which may be hardened high carbon steel, hardened stainless steel, beryllium copper or just plain brass depending on the type of meter application and the accuracy desired in the instrument. Even though the forces involved may only be a total of one ounce or so, the point of contact may be smaller than the point of a needle resulting in extremely high unit stresses. The amount of the material required in each meter is very small so the cost of the wire is a secondary consideration as long life and continued accuracy is essential and demands the best possible material.

✦ ✦ ✦

COPPER wire one thousandths of an inch in diameter is used in large quantities on these meters for the winding elements and on one special meter, wire only ¼ of a thousandth of an inch in diameter is used and is made from silver to reduce the resistance of the winding.

Tungsten Filament Wire

IN the manufacture of lamps, the tungsten wire used for the filament is a very special item. This tungsten wire carries the current and operates at an incandescent temperature to produce the light. No substitute has ever been found which is nearly as good for making these filaments. This is because tungsten has the peculiar combination of valuable properties. It has the highest melting point, 3380K. It has the highest tensile strength, 500,000 lbs. per sq. inch when drawn into fine wire and it retains its stiffness when incandescent. These qualities make it unique for use in lamp filaments and the nearest competitive material does not come near it in these unusual properties.

✦ ✦ ✦

THE tungsten wire is drawn to very close tolerances in order to accurately control the resistance in all sizes down to one-half thousandths of an inch in diameter. For one special lamp, wire of .00022 inches in diameter is required.

✦ ✦ ✦

ON a standard 3 watt lamp, wire .00035 inches is used and is coiled into a helix .002 inches in diameter and has 1900 turns per inch. This coil is so small that the individual turns cannot be seen without a magnifying glass. The machine used to manufacture the units are equipped with microscopes that magnify 30 times so that the operator can see the work being done.

✦ ✦ ✦

Lead-In Wires

ANOTHER interesting wire that is used in the manufacture of lamps is the lead in wire which is a composite wire consisting of a copper sleeve on a nickel-iron core which is used for sealing through soft glass and therefore must have the proper coefficient of expansion. This coefficient of expansion is dependent upon the composition of the core material which must be accurately controlled and also upon the ratio of copper to nickel-iron. This wire is manufactured by brazing the copper sleeve on to a rod of approximately ½ inch in diameter and then drawing to fine wire sizes. It has been found that the ratio of copper to nickel-iron remains practically constant during the entire drawing operation providing a good job of brazing has been done.

THERE are also many other interesting applications of wire in the manufacture of lamps which time does not permit to describe, but it is evident that a tremendous amount of research and development work has been involved in the manufacture. While it is usually agreed that the most spectacular things in the electrical industry are the tremendous machines which are built to generate, transform and use electric power, the most spectacular uses of wire are in some of these small units just described.

✦ ✦ ✦

Spring and Armature Banding Wire

TWO of our most important applications of steel wire are for use in springs and for banding wire of motor armatures. The springs may be a very small size used in meters or they may be the large coil springs used in electric locomotives requiring several thousand pounds to give a compression of one inch. Our problems in the manufacture of springs especially making them resistant to corrosion is a subject itself, and I know that several papers have been pre-

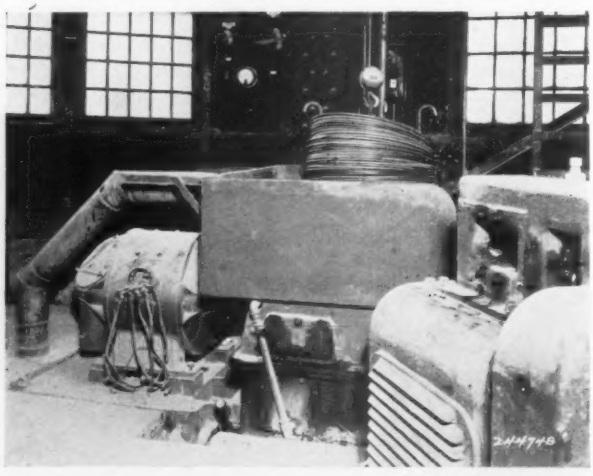


Fig. 1. This is an installation showing a single block machine used largely for drawing special sizes of rod for bolt stock. We understand this machine is capable of handling rods up to ⅝ of an inch in diameter. The machine is driven by a 50 HP. D.C. adjustable speed motor timed to run at the low speed on the motor for the drawing of the heavy sizes and for correspondingly higher speeds for the smaller rods. The view shown here indicates the measures which have been taken to protect the motor from dirt. This is a rather dirty location with a large amount of lime dust and other materials in the air and so air is brought from outside the building through a pipe and fed through the motor by means of a fan built into the motor itself and then discharged back into the room. An indicating ammeter is used to give the operator an idea of the permissible drawing speeds that he can use for the different size rods without overloading the motor. ✦ ✦ ✦ ✦ ✦

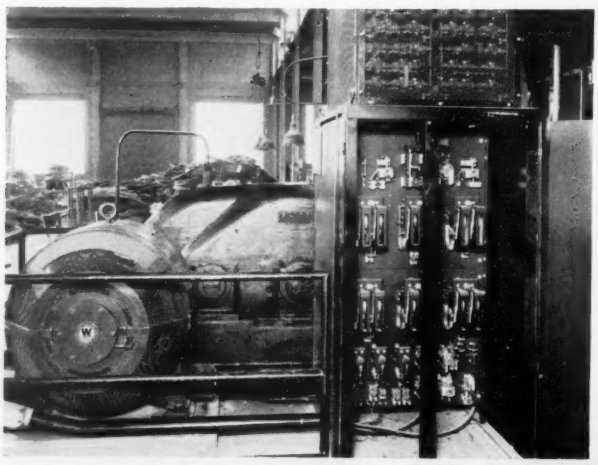
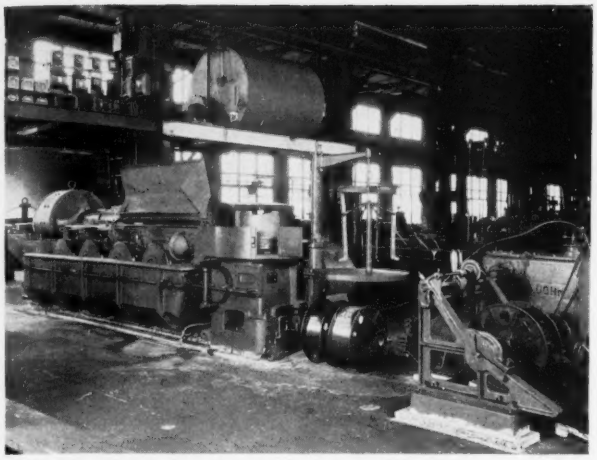
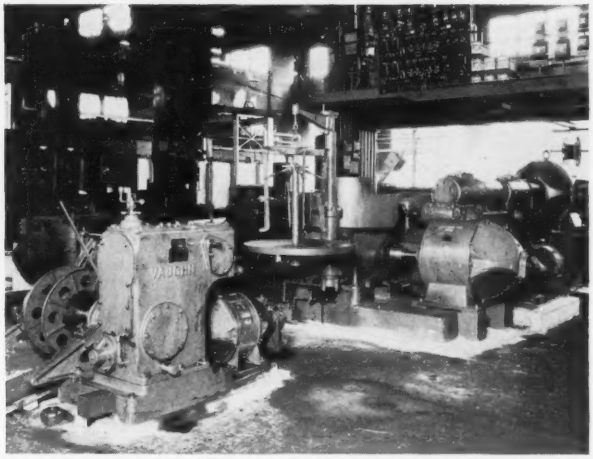


Fig. 2. This is another view of a single block machine for drawing heavy rods and is different in design in that it has a horizontal block instead of a vertical block as on the previous machine. This block is also driven by an adjustable speed D.C. motor and since some various types of alloy wires are drawn on this machine which are very hard and difficult to grip with tongs, the control has been provided with a very slow inching point to take up the slack with the minimum amount of shock. This low speed is less than 1/12 the maximum speed of the machine. The speed adjusting rheostat can be seen at the right hand side of the block and this rheostat has its faceplate calibrated both in RPM of the motor and in feet per minute so that the operator can set up his machine for any desired wire drawing machine accurately. The control is of the heavy duty steel mill type with an enclosing cabinet and with all resistors mounted on top of the cabinet. This unit is shipped completely wired and assembled from the factory resulting in the minimum cost and time for installation after being received at the plant. ✦ ✦ ✦ ✦ ✦





Figs. 3 & 4. This is a tandem wire drawing machine of special design with 4 horizontal blocks driven by a D. C. adjustable speed motor and with a fifth block of vertical design driven by a separate D.C. adjustable speed motor. This machine also includes a reeler with provisions for winding the wire up on the reel under a tension. This machine is installed in our own copper mill and is used primarily for drawing special sizes of round wire which are later rolled into rectangular sections in the wire to be used in the manufacture of transformers. Note the magnetic control used for the machine shown in the previous photograph. In this case the control equipment is mounted overhead in a control balcony rather than on the floor in an enclosing cabinet.

sented before the Association on the subject.

✦ ✦ ✦

BANDING wire is a very important item in rotating machinery as it is the means for holding the coils in position against the centrifugal forces produced by the high rotating speeds. This banding wire is normally of ordinary high carbon steel with high tensile strength but on certain special machines such as the A. C. series wound motors used on the huge high speed electric locomotives and the high speed lightweight generators used by the aviation industry, the bands are made from stainless steel. The stainless steel is desirable because it is non-magnetic and also has a higher resistance than the ordinary steel banding wire. If steel banding wire was used for these applications, a sufficient amount of losses would be generated to cause them to become hot enough to melt the solder and would also produce sufficient magnetic disturbances in the motor to adversely affect the commutation of the machines. In other machines stainless steel is being used purely as a means of preventing corrosion and the use of stainless steel in machines for this reason is expected to increase.

Copper Wire Requirements

PROBABLY the most important characteristics for copper wire neglecting its low resistance which is used in our large machines is not the characteristic involving strength, temperature, etc., but the necessity for a good surface finish. In many cases, the thickness of the insulation especially on small enamel and paper covered wire is only a thousandth of an inch and a small sliver on the surface may easily make the insulation ineffective and cause a failure of the motor when placed in service. Elaborate precautions are taken to avoid this condition and all machines are carefully tested

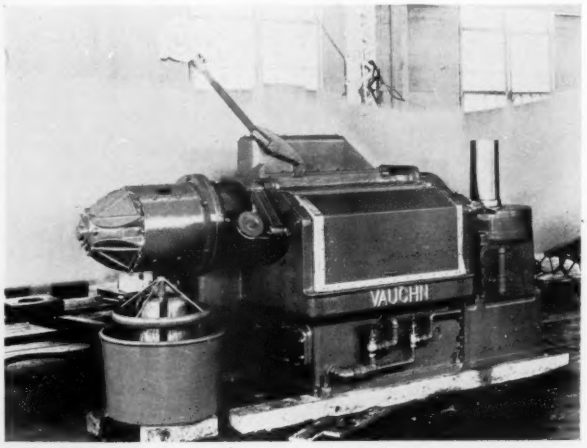


Fig. 5. This photograph shows a small wire drawing machine that is typical of many of the smaller units designed for handling small wire and for drawing wires of special characteristics. As indicated by the small motor, the electrical problems are usually greatly reduced and all that is required in the way of equipment for a machine of this type is a good rugged D.C. motor of the necessary mechanical arrangements along with a suitable magnetic starter to give smooth acceleration. The motor has a 3 to 1 speed range in order to give various delivery speeds for various types of wires. ✦ ✦ ✦ ✦ ✦

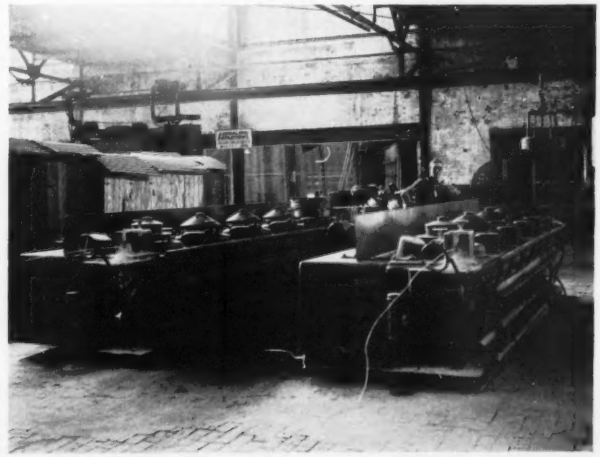


Fig. 6. This shows a 5 block tandem wire drawing machine used for drawing steel wire, each block having a D.C. adjustable speed motor and with the speed automatically regulated by means of dancer arms between each block. ✦ ✦ ✦ ✦ ✦ ✦

Fig. 7. This is another view of the same machines showing the mounting arrangement of the D.C. motors. These motors are arranged to give a compact arrangement and also to amply protect the motors from damage. These machines are air-cooled and the air that is used for cooling the dies circulates through the motors so that a good supply of cooling air flows through the motors at all times regardless of whether they are rotating or standing still.

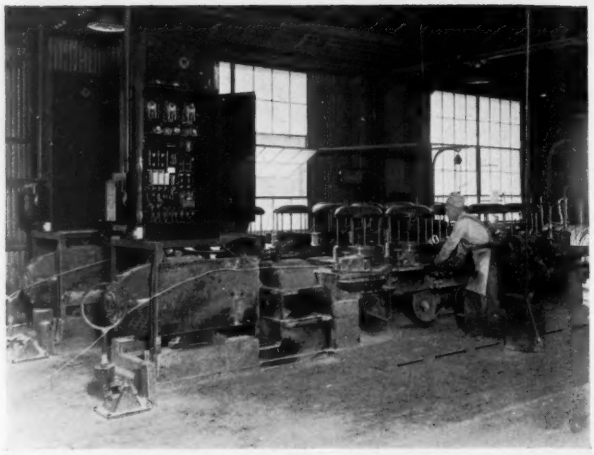


Fig. 8. Tandem wire drawing machine on which a single motor is used. In this particular installation, the machinines are driven by a wound rotor induction motor, and have only one delivery speed. The wound rotor is used to get a smooth and gradual acceleration. When these machines are used for continuous operation and with a welder, arrangements are made for individual clutching and declutching of a given block in order to take care of any excess wire that may develop on any part of the machine. You will note that in this arrangement the motor is located at one end of the machine and the control is mounted on a platform directly overhead in order to conserve floor space.

before shipment. However, there have been cases of failure involving very expensive shutdown and repairs where the evidence pointed to damage of insulation due to a bad surface of wire. This point is always extremely difficult to prove since the damage by the failure usually destroys any evidence of the bad wire.

✦ ✦ ✦

IT is evident that the production of wire to meet these special requirements has meant the development of new processes and new machinery for drawing the wire. Even though the requirements are becoming more rigid as to finish, strength and other properties, the modern wire mill is drawing this wire at drawing speeds considered impossible a few years ago. This is probably especially true on the various grades of steel wire. This has been made possible in part by better steel being delivered to the mill, but the improvements in the wire drawing machinery have had an important part.

✦ ✦ ✦

Wire Drawing Machinery

WE are all familiar with the old arrangement of long rows of single hole blocks all being driven from a line shaft through bevel gears and a mechanical clutch. Here the speed of drawing the wire was determined by the maximum speed the gears could be running when the clutch was connected without tearing up the clutch, jerking the tongs off the wire, or breaking the point of the wire. While the drawing speed on these machines are usually around 300 or 400 feet per minute, the same wire is now being drawn at 1500 feet per minute and in many cases even higher speeds are being used. These speeds were accomplished by the development of the unit type of machine consisting of either a single block or several blocks in tandem, all blocks being driven from a common motor or as later developed, each block in tandem being driven by an individual motor.

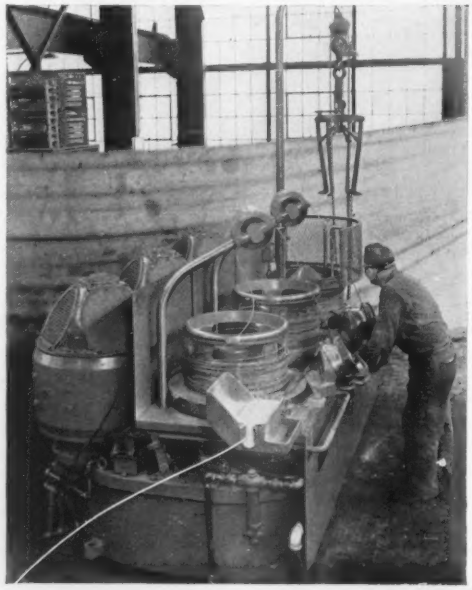


Fig. 9. This is a view of a 3 block tandem wire drawing machine similar to those shown previously except that the vernier rheostat mechanism has been eliminated and wire is allowed to accumulate on each block so that no harm is done if the motors are not quite synchronized in speed. Each motor is provided with a vernier rheostat so that the operator can readily adjust the speed of any one of the motors if practically all of the wire has been removed from one block or if too much wire is accumulating on the block. In this arrangement you will note that the motors instead of being mounted horizontally are mounted vertically and the unit makes use of double reduction helical gearing instead of right angle gearing. These motors, as on the other type of machine have been especially designed both mechanically and electrically for this wire drawing service.

✦ ✦ ✦

IN the old days, the people drawing wire were not even interested whether there was such a thing as an electric motor and probably did not even know whether the line shaft that supplied power from their blocks was driven by a motor or a steam engine.

✦ ✦ ✦

HOWEVER, the electric motor is necessary for these unit type of machines and new electrical equipment is a very essential and important part in nearly all wire drawing machinery.

✦ ✦ ✦

Electric Motor Types

A FEW words in regard to the type of electric motor that should be applied to the various types of wire drawing machine are in order. Naturally, the cost of the electrical equipment will vary almost directly in the ratio of what it is expected to do. If the wire drawing machine is to run practically continuously at a constant speed without any special accelerating problems, a standard squirrel cage induction motor with a simple Linestarter control is all that is required. An attempt is always made to use A. C. power when possible as many of the wire mills do not have an adequate supply of D.C. power. In addition, the cost of A.C. power is always less than D.C. power since it eliminates the necessary conversion from A.C. to D.C. unless it is one of those unusual plants where power is generated directly as D.C. current.

✦ ✦ ✦

ON certain types of wire drawing machines frequent starting and stopping with a smooth acceleration is required. Yet the machine is such that all wire can be drawn at given speed. For this case it is satisfactory to use an A.C. motor with a wound rotor which is somewhat more elaborate and expensive than the standard squirrel-cage induction motor, yet it does given better starting conditions and is used on quite a few of the single block and tandem wire drawing machines.

✦ ✦ ✦

ON other types of wire drawing machines where it is desired to have two or three drawing speeds, but where starting and stopping is not important, it is possible to use a 2 or 3 speed squirrel cage induction motor, although this is a rather unusual case. If the smooth and gradual acceleration is required, the complications of the two or three speed motor with a wound rotor is such that the motor is impractical to build, and makes the motor and control very expensive.

✦ ✦ ✦

D.C. Adjustable Speed Motors

TO meet the requirements just mentioned, it is the usual practice to use the well-known D.C. adjustable speed motor. With this motor it is possible to get a very smooth acceleration and it is also possible to get a slow creeping speed on these motors for threading up the machine. By means of field control it is possible to get a range in drawing speed as much as 4 to 1, although this range is more frequently held down to approximately 3 to 1 ratio.

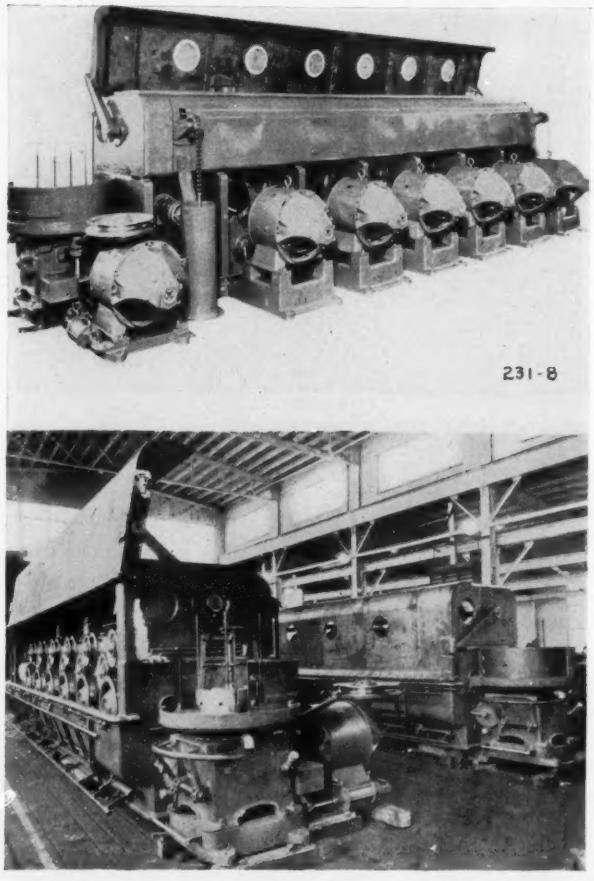


Fig. 10. This photograph shows views of what is probably the largest wire drawing machine of the continuous type ever built. This machine stands approximately 8 feet high by 40 ft. long and has 6 horizontal blocks and one vertical block. Each block is driven by a motor with a maximum rating of 75 HP and is capable of delivering wire at about 1600 feet per minute. The seven motors represent a total HP. of 525 HP. and it is evident that when all of this energy is put into the wire in the drawing process that a tremendous amount of heat must be dissipated. These machines are used mainly for drawing copper clad steel wire and so are designed on the basis of a liquid lubrication. On the other hand, the core of this wire is usually a high carbon steel with very high tensile strength so that the HP. requirements are large.

✦ ✦ ✦

IT is evident that such a machine is very flexible and can be called upon to draw almost any kind of wire. On the other hand it requires more elaborate and more expensive electrical equipment.

✦ ✦ ✦

PRACTICALLY all copper wire is drawn by the so-called slip method on tandem wire drawing machines with some liquid for lubrication. With this arrangement one motor can drive several blocks through suitable gearing and by the proper selection of this gearing and the reduction taken at each hole, there is very little slip between the wire and the blocks. Some operators feel that this slip affects the finish and may be objectionable for some applications. However, when drawing steel wire where it does not seem practical to use a liquid lubrication, the slipping of the wire on the die is more objectionable and the machines have been developed which eliminate this feature. Since the dies can never be held exactly correct, there is always a tendency to underfeed or overfeed on any given block and therefore if a single motor is used provision must be made to allow the wire to accumulate on given blocks or special arrangements made to compensate for it.

✦ ✦ ✦

ON certain types of tandem wire drawing machines a D.C. adjustable speed motor is placed

(*Please turn to Page 346*)

Visit of The Wire Association To The Norton Company

A description of the plant inspection trip made and the production processes seen in connection therewith, at the Worcester Regional meeting of the Wire Association. ✦ ✦

ON the afternoon of April 25 **Norton Company** was host to the members and guests assembled in Worcester for the Regional Meeting. Here they were first given the opportunity of seeing the well-arranged exhibits of products in the Norton Memorial Hall and the murals representing the various steps in the manufacture of Norton abrasives and machines. They then saw the chief operations in the manufacture of grinding wheels, including the mixing, pressing, shaving, firing and finishing. They were given an opportunity to inspect the very modern washroom layout which has been provided and also the extensive and very effective dust collecting system which prevents contamination of the atmosphere in the new, modern, well-lighted building. They then were taken through the new Plant 1 where they saw the grading, inspection, and speed testing of wheels and finally the packing department.

✦ ✦ ✦

IN the evening **Mr. Milton F. Beecher** of the Norton Company gave them a short talk at their dinner meeting in the Bancroft Hotel. He chose to discuss some features of research at the Norton Company to point out its relationship to the improvement of abrasive products used in the wire industry. Perhaps of most interest to the visitors were the comments relating to boron carbide. This was used as an example of a research project in process, where only partial success has been attained, but where the material has such promising physical properties that it seems worth while to press the research and development work to a final conclusion. The wire industry has helped materially in the testing of Norbide wire-drawing dies, and while a successful die has not yet been produced, the Norton Laboratories are following up the problem persistently in order to supply, by changes in product or process, the shortcomings which have been disclosed by the tests to date.

✦ ✦ ✦

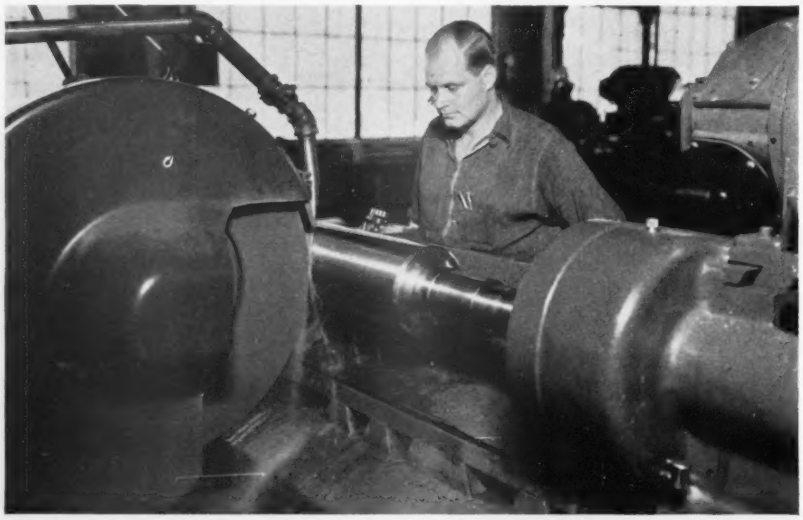


Fig. 1. Roll Grinding.

✦ ✦ ✦ ✦ ✦ ✦ ✦

A PLANT engaged in production work, large or small, or in precision work of any kind, will profit materially by a better understanding of grinding wheels and grinding action—where each type and each structure can be used to best advantage, what changes can be made in the operating conditions to turn out better work more quickly, and what can be changed in the wheel itself to bring about a desired result. Grinding wheel manufacture today embraces such a wide scope of possibilities that almost never is a man who knows grinding wheels baffled by the question "Can I grind it?"

✦ ✦ ✦

Grinding and Abrasives

GRINDING is an operation that covers such a variety of materials—from wood to steel; and such a wide range of conditions—from slotting a fountain pen point gap only .006" wide to snagging heavy gates from huge steel castings—to the grinding of pulpwood with immense 72" x 54" pulpstones—that it is inconceivable that one abrasive should do for everything. Forty years ago, when "emery wheels" were really made of emery, grinding was limited to only a relatively few standard operations. Today almost every manufactured article is pro-

duced directly or indirectly, by grinding.

✦ ✦ ✦

THE abrasives used almost exclusively today are products of the electric furnace. They may be classified into two general groups — the aluminum oxide abrasives and the silicon carbide abrasives. There are several "makes" of each, known by various trade-marks.

✦ ✦ ✦

"ALUNDUM" is a crystalline form of aluminum oxide, formed by fusing in the electric furnace a soft clay-like mineral, called Bauxite. Bauxite is mined in surface deposits in Arkansas, fused at the Norton electric furnace plants with the aid of the enormous electric power development at Niagara Falls and crushed and screened into uniform particles or grains of proper size at the main plant in Worcester, Massachusetts.

✦ ✦ ✦

IN general, Alundum abrasive is used for grinding materials of high tensile strength — materials that are hard, yet tough and strong.

✦ ✦ ✦

"CRYSTOLON" designates Norton silicon carbide abrasives, and derived products. This silicon carbide is produced by the electric furnace reaction of pure silica sand and coke. A small amount of sawdust is added to help the reaction along.

✦ ✦ ✦

HEAVY castings of iron and brass are snagged with "Crystolon" wheels. Because it is harder than "Alundum", it will penetrate and grind materials having close, dense grain structures. Building stone, marble columns and granite blocks are formed and cut with wheels made of "Crystolon" abrasive.

✦ ✦ ✦

BY the term "bond" is meant the material in the grinding wheel that attaches each grain of abrasive to its neighbors. Bond is not an abrasive—it is just a holder to support the abrasive grains while they grind. With any given type of bond, it is the **amount** of bond that determines "hard" wheels or "soft" wheels. Actually, the abrasive itself in all wheels is extremely hard.

✦ ✦ ✦

MOST grinding wheels are made with a vitrified bond, which may be one of several types of clay.

✦ ✦ ✦

ALTHOUGH generally limited in operating speed to 6500 surface feet per minute, vitrified wheels are strong enough for very heavy work. They are capable of extremely rapid removal of material and may be found in the whole grinding field, except where unusual conditions prevail. "BE" Bond is a designation for a Norton Company patented vitrified bond of high purity and extremely stable characteristics. It is entirely transparent, producing a white wheel with 38 Alundum abrasive and a blue-gray wheel with "regular" Alundum. "BE" Bond is not applicable to Crystolon products.

✦ ✦ ✦

SILICATE bond permits the release of abrasive grains more readily than in vitrified bonded wheels. For practical reasons of manufacture, silicate bond is resorted to in the making of very large solid wheels.

✦ ✦ ✦

RESINOID bond is one of the so-called "organic bonds" used for the majority of the high speed wheels in foundries and billet shops. It is true, in most cases, that the rate of stock removal is in direct proportion to the speed at which the grinding wheel operates. Resinoid bonded wheels are designed to operate at 9500 surface feet per minute on swing frame and floor stand grinders used in the snagging of castings and in the removal of scale and defects from billets. Resinoid bonded cut-off wheels, operating at 16,000 surface feet per minute, on proper equipment, will cut cleanly through a one inch steel bar in a few seconds.

Fig. 2. Billet Grinding with Swing Frame Grinders.

✦ ✦ ✦ ✦

✦ ✦ ✦

RUBBER, another of the organic bonds, is a factor in high speed grinding. It affords rapid stock

(*Please turn to Page 345*)

WIRE WORKING MACHINERY
and
WIRE-MILL EQUIPMENT

Our Complete Line

ARMORING MACHINES
—Cable — Hose — Wires

BOOK BINDING MACHINES
—Wire Spirals

CABLE ARMORING MACHINES
COILING MACHINES
—Key Ringing — Metallic Tube
—Spiral — Springs — Strip
—Torsion — Bi-metal

DRAWING MACHINES
—Continuous — Single Hole

FLEXIBLE CASING MACHINES
—Speedometer Shaft — Radio Control
—Choke Wire

FLEXIBLE TUBING MACHINES
—Wire — Strip

KEY RINGING MACHINES
—Wire

LOCK WASHER MACHINES
—Rotary — Press Type

REELING MACHINES
—Strip — Wire

RING COILING MACHINES
—Wire — Strip

ROLLING MILL MACHINES
—Flattening Wire — Shape Wire

SPOOLING MACHINES
—Strip — Wire

SPRING MAKING MACHINES
—Spiral — Torsion

STRAIGHTENING & BUNDLING MACHINES
—Processing Wire

STRAIGHTENING & CUTTING MACHINES
—Wire

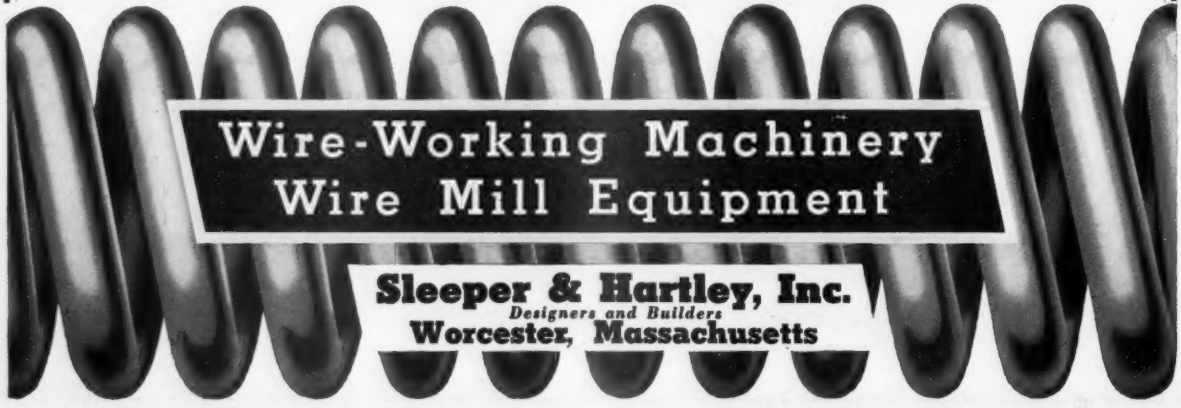
TAKE-UP MACHINES
—Patenting — Galvanizing
—Tinning — Cable — Rolling Mills

THERMOSTAT WINDING MACHINES
—Bi-metal Coils

TORSION SPRING MACHINES
—Choke Coils — Springs

TUBE COILING MACHINES
—Flexible Metallic — Interlock

WIRE MACHINES
—Armoring — Bundling — Coiling
—Cutting — Drawing — Forming
—Key Ringing — Processing
—Reeling — Rolling — Ringing
—Spiral — Spooling — Straightening
—Take-ups — Winding



The Carbide Die History, Manufacture and Use

By Dr. E. W. Engle,
Carboloy Co. Inc., Detroit, Mich.

A study of the development of the carbide die, the present method of manufacture, and of the many diversified uses for dies and tools in general industry. A paper presented before the Pittsburgh Regional Meeting of the Wire Association at Pittsburgh, Pa., May 5, 1939.

IN the later years of the 19th century and the earlier years of the 20th, **Henrie Moissan,** celebrated French scientist, did his classical work with the electric arc furnace. This furnace, in which heat is developed by means of an arc between one or more pairs of carbon or graphite electrodes, is known as Moissan's furnace.

✦ ✦ ✦

MOISSAN reduced oxides of refractory metals, such as titanium, zirconium, vanadium, molybdenum, and tungsten, producing the metals and their carbides in a state of more or less purity. He also succeeded in producing diamonds artificially by crystallization of carbon from molten iron suddenly cooled from high temperatures under conditions to give enormous pressures. Crystalline diamonds of maximum diameter of about one-thirty-second of an inch were obtained. Artificial diamonds have, however, never been able to compete with the natural product. The carbides of the refractory metals do not exist in nature to any appreciable extent, and their use necessitates synthetic or artificial production. Moissan's work paved the way to the hard metal carbide industry and to a somewhat lesser degree to sintered powder metallurgy, even though his type of furnace is now practically obsolete in this metallurgical art. **Moissan's** work was summarized in his book **"The Electric Furnace"** 1904.

✦ ✦ ✦

CLOSELY following the work of **Moissan** came the development of the metal filament incandescent lamp, and along with this the production of tungsten wire, the metal being produced initially as powder and processed to wire without fusion. A step in this process is the firing or sintering of a pressed billet of powder, somewhat below the fusion point. Thus was started sintered powder metallurgy, or as the Germans aptly term it, the Metal Ceramic Art.

✦ ✦ ✦

DR. EDGAR W. ENGLE

Education — Public Schools, Buffalo, Mo.; Drury College, B.S.; University of Illinois, M.S., Ph.D. Positions—Past: Instructor in Chemistry, Univ. of Illinois; Metallurgist and Chief Engineer, Fansteel Products Company; Consulting and Research Metallurgist, Tungsten Tool Company. Present: Carboloy Company, Inc. Member — Scientific Societies, The Electro-chemical Society, Institute of Metals, Great Britain, American Inst. of Min. and Met. Eng. Fellow—American Ass'n. Advancement Science. Honorary Societies — Sigma Xi, Phi Lambda Epsilon (Chemical)

TUNGSTEN is of such a nature that the commercial production of wire requires hot working and drawing. It proved commercially practical to hot swage the billet to a diameter of about one-thirty-second of an inch, though this was a slow and laborious process. Steel and cast iron dies as used for the cold production of wire were not satisfactory for hot drawing tungsten and sapphires were lacking in strength. Diamonds were available and were used, though the expense was extremely high in the larger sizes, due to initial cost and excessive breakage. In the finer sizes as used for finished filaments, the temperatures required were less, the diamonds smaller, and the breakage less frequent and the problem was not acute.

✦ ✦ ✦

BECKER, in his book **"High Melting Hard Materials and Their Technical Application—1st Edition —1933 (in German)"** and in a series of articles in the magazine **"Metallwirksclaft—1933** (in German)" traces in some detail the development of the hard metal practice and the patent art accompanying. An excellent summary was presented by **Hoyt** in his **"Institute of Metals Division lecture of the A. I. M. E."** in 1930, more recently **Smithels'** and **Jones,** in British publications have discussed the art and its development and there have been numerous articles in technical and scientific publications, including some in Wire and Wire Drawing. No attempt here will be made to give a complete bibliography.

✦ ✦ ✦

BECKER makes first reference in the art of the German patent of **Lohman** and **Voigtlander**, 1914. In this is described the manufacture of molded bodies by melting oxides of tungsten and molybdenum with carbon in a carbon mold in a carbon resistance furnace. In another patent to the same inventor, molded pieces of tungsten and molybdenum carbide are sintered in carbon molds to just below their fusion temperature.

✦ ✦ ✦

AT about the same period was described a process for the production of hardened articles of tantalum, by heating the ductile metal to produce a hard surface, working the resultant metal to embed the hard surface material into the softer body and repeating the operation until the desired depth of hardening was obtained.

✦ ✦ ✦

IN the early development, attempts to produce a satisfactory hard metal carbide material were carried out, both by fusion and sintering processes. Along with the desired high hardness of the carbides goes a very high fusion and sintering temperature, well in excess of 2000°C. (3632°F.). Difficulties of operating at such temperatures are evident. Also, the materials produced were relatively weak as compared with alloy steels. The desirability of reducing the processing temperature and increasing the strength was obvious.

✦ ✦ ✦

CONTINUED work resulted in a product in which the finely divided hard metal carbide or carbides are embedded in a matrix of a lower melting, less hard, and tougher metal or alloy. The patent art of recent years on this subject is quite voluminous, so much so that **Becker** in his conclusion in **"Metallwirkschaft — Nov. 17, 1933"** states a critical review of all these new patents which have been quoted and discussed shows that as far as patent protection of the hard metal field is concerned, the end of the development has been reached; since actually the united field of hard alloys of high fusibility, be it carbides, silicides, borides, or nitrides alone, or in all kinds of combinations, in their use as hard constituents of the sintered hard metals, are covered by patent protection. It is probably quite unlikely that one or more new variations could be found, which would fall into the field of one or several previously granted patents'. It is not within the scope of this paper to explore the patent field further. Sufficient it is to say that since **Becker's** statement was published, patents in the field continued to issue at only a slightly diminished rate.

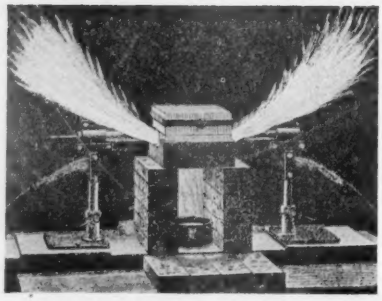
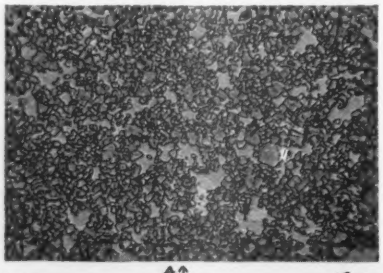


Fig 1. From a wood cut Modern Inorganic chemistry Mellor 1912.

✦ ✦ ✦



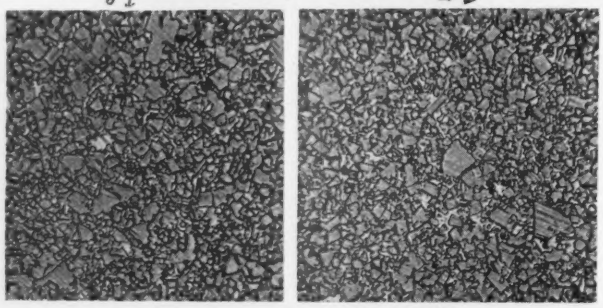


Fig. 2. shows structure at 1500x of typical grades used for wire dies.
a. 74% Tungsten Carbide, 20% Tantalum Carbide, 6% Cobalt.
b. 91% Tungsten Carbide, 9% Cobalt.
c. 87% Tungsten Carbide, 13% Cobalt.
Inst of Metals vol. 138—(Refer Sykes—McKenna—A. I. M. E. 1938)

FROM the practical standpoint of the constituents of the materials used for wire dies, compositions are almost completely limited, in the writer's knowledge, to tungsten monocarbide, WC, with a binder of cobalt or nickel, and to tungsten and tantalum carbides in combination with similar binders. A much wider variety of combinations is used for tools requiring a sharp cutting edge.

✦ ✦ ✦

THE basic processes involved are inherently simple and as in the case of almost all proper manufacturing processes require considerable experience, control and technical knowledge to assure the production of a uniformly satisfactory product. Details are given in the publications already referred to. The usual process is to make the carbides in finely powdered form from metal powder or oxides in the presence of carbon, with a view of obtaining a fairly definite composition, closely approaching a theoretical chemical compound.

✦ ✦ ✦

THE carbide in the desired grain size is milled with the binder, in powder form, until each particle of carbide has on it a coating of the binder material.

✦ ✦ ✦

TO form the wire die nib, the resulting mix is molded under pressure to give the approximate size and shape of the nib, due allowance being given for shrinkage during the heat treatment or sintering and to excess allowance required for finishing the hole in the assembled die to final dimension. The sintering operation may be carried out at atmospheric pressure, or it may be done under applied pressure. Sintering temperatures used are of the order of the melting temperature of the binder metal, and a certain amount of fusion is usually considered as taking place. In the case of compositions commercially used of tungsten carbide and cobalt, the re-

action between the two is regarded as of a minor nature, but with the usual mixtures containing tantalum carbide there appears to be appreciable reaction between carbide and binder with considerable structural modification.

✦ ✦ ✦

WYMAN and KELLY (Tech. Pub. #354—Class E—Inst. of Metals, A.I.M.E. 1930—Sept.) have studied the action of the cobalt cementing material in sintered tungsten carbide compositions. They examined specimens varying in initial composition from pure cobalt to 97% tungsten carbide with only 3% cobalt. Commercial grades range from 3% to about 25% cobalt.

✦ ✦ ✦

ABOVE 45% tungsten carbide, only two constituents were visible, angular grains in a uniform matrix, the typical structure of the commercial ranges. At 35% tungsten carbide, the angular grains first come into evidence. At 27.5% tungsten carbide, a eutectic structure was most evident, disappearing around 15%. A needle like phase appeared at 5 to 10% tungsten carbide. The specimens described had had a sintering treatment at 1400°C. (2552°F) for 1½ hours, which is probably somewhat longer than present general practice. The authors conclude that the binding constituent usually reaches the liquid state at the sintering temperature, contains dissolved tungsten carbide, and that upon solidifying this cobalt-rich cementing material remains as a solid solution of tungsten carbide in cobalt.

✦ ✦ ✦

TAKEDA has determined equilibrium diagrams of the cobalt-tungsten carbon, and nickel tungsten-carbon system. **(Research Inst. Report for Iron, Steel and other Metals 1932-3).** He considers that as sintering proceeds in the cobalt composition, the volume of the melt, due to solution of WC, becomes approximately twice that of the initial cobalt. At the time of solidification there remains about 4% WC in solution; this diminishing to 1% at low temperature. Hence he concludes the composition remains much the same before and after sintering. He considers, in the use of a nickel binder, that much more WC remains in the binder on cooling from sintering than is the case of the cobalt mix.

✦ ✦ ✦

MEYER and EILANDER (Archive for Eisen Luttenwesen—Vol. II—May 1938) give results of a study of sintering of hard metal alloys, under various conditions of pressure, sintering time and temperature, particle size and composition size and composition. Their work was with laboratory experimental materials rather than with commercial products.

Fig. 3. Large die as used for sheet metal drawing—such as ordnance shells. Diameter of hole six inches. Diameter of steel casing fourteen inches.

Fig. 4. Shows relative dimensions of largest and smallest types of carbide dies in commercial use.

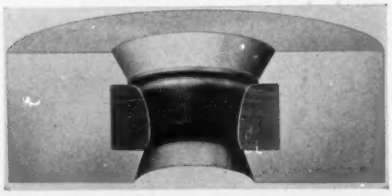


Fig. 5. Shows cross-section of interior of dies.

✦ ✦ ✦

THE wire die nib, as sintered, is generally a cylinder with a diameter approximately equal to, or somewhat greater than its height, in diameters under one inch.

✦ ✦ ✦

IN the larger sizes for use, mainly for rod and tubing, and sheet metal forming and drawing, the diameter of the die nib is generally considerably in excess of the height. The hole is preformed to somewhat smaller dimensions than the initial finishing size, and except for the very small finish hole size, .015″ and under, extends all the way through.

✦ ✦ ✦

AS compared with steel, the nib is hard and brittle, having a Rockwell C hardness from 71—with 13% cobalt—to 82—with 3% cobalt, and a Rockwell A hardness from 87—with 13% cobalt—to 93—with 3% cobalt, and a modulus of transverse rupture ranging down from 300,000# per square inch. The compressive strength is extremely high and the tensile rather low. The material has great ability to retain strength at elevated temperatures, a grade—having at room temperatures—a modulus of transverse rupture of 225,000, having a 800°C, 183000—and at 900°C—111,000 pounds. This fact, coupled with the known suitability of carbide dies in hot drawing tungsten and molybdenum wires, leads **Thompson** — in his article **"Fundamentals of Wire Drawing (Iron Age V142-15, Oct. 12, 1938)** to the conclusion that heating of carbide dies is not in itself harmful, **providing the heating is uniform.** This, of course, would hold true only to temperatures at which the lubricant continued to function properly. This will be further discussed in a later paragraph in connection with galling and flaking.

✦ ✦ ✦

FOR most uses it is highly desirable to case the die nib within a mechanically supporting member. The prime function of the nib is to give a non-wearing —non-distorting surface to withstand the drawing forces. The mechanical backing can generally be secured by the use of a less expensive material, such as steel, bronze, monel, etc. The nib may be secured in the casing by means of mechanically pressing, brazing, hot shrinking, hot forging, or by actually casting the casing around it.

✦ ✦ ✦

IN the writer's experience the forging method, using a heat treatable steel casing material, provides excellent support for all outside surfaces of the nib.

✦ ✦ ✦

THE ideal assembly is perhaps one in which a spherical nib is set into a hollow spherical casing in such a way that the desired compressive forces to counterbalance the drawing pressures are exerted by the casing on the nib. However, practical considerations — such as a necessity for a hole for the wire to enter and leave—the desirability of holding the die in definite position through plane or cylindrical surfaces, both in use and in resizing, preclude the use of such ideal structure.

✦ ✦ ✦

IN the practical structure, the top and bottom outside edges of the nib may be beveled and the steel cylindrical casing be of a thickness sufficiently greater than the nib to provide considerable support on both the front and back of the nib.

✦ ✦ ✦

THE thermal expansion of the carbide die nib is considerably less than that of steel, being about one-half.

✦ ✦ ✦

IN the cooling following forging with the properly selected type of casing steel, the casing shrinks tightly against the nib. The degree and nature of this support are determined largely by a later heat treatment, which in turn depends somewhat upon the service to which the die is to be put.

✦ ✦ ✦

CASING dimensions have been standardized on the basis of actual die and mill experience, and it is generally hazardous to attempt operation with an under-size casing, on account of limited support to the nib. A test sample of a largely used casing steel heat-treated in the manner used for a standard one and one-half inch diameter casing gave the following values: tensile 182,000, yield 129,000 pounds per square inch, elongation in 2"—4.5%, reduction in area 5.05%; hardness C-37-40. This specimen was heat treated at 1½" diameter and machined to standard tensile specimen size for testing.

✦ ✦ ✦

LARGER casing diameters may well be treated to somewhat less hardness of approximately 30 Rockwell C.

✦ ✦ ✦

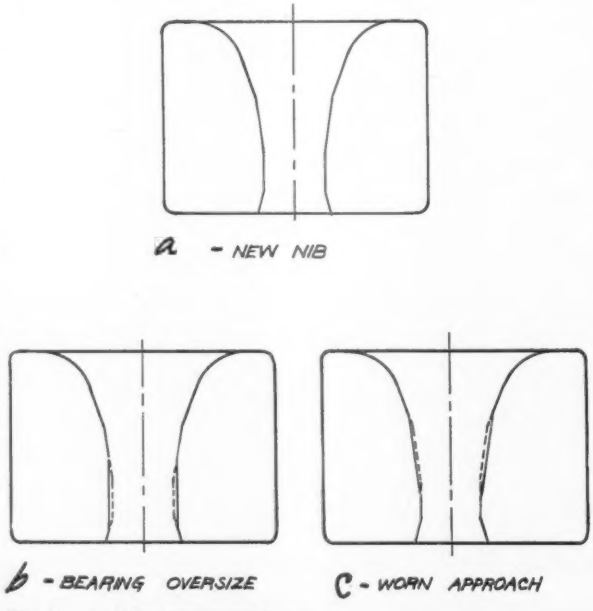


Fig. 6. a. hole shape as put in use.
b. bearing worn oversize, will resize to next draft.
c. approach or working area oversize, part of bearing still on size, must be recut more than one draft to resize.

IT should be borne in mind that the major purpose of the casing is to give mechanical support and compressive backing to the nib. If conditions arise in use which will lessen these, as—for instance—permitting the casing to become too much heated, such abuse may in all likelihood result in broken or chipped dies. Excessive temperatures cause the casing to expand away from the nib due to the greater thermal expansion of the casing material.

✦ ✦ ✦

AMONG the most important things to be given attention in the drawing of wire, so far as the die is concerned, are hole shape, finish, lubrication and alignment. No general discussions of hole shape will be attempted here. This has been discussed in numerous articles and a summary is given in Bonzel's book already referred to. **Jennison (Transactions AIME—Inst. of Metals, Div. 1930)** discusses this from the standpoint of copper drawing, and **Thompson (Iron Age, Oct. 13, 1938)** gives a general summary. There appears general agreement that the die hole should consist of a series of concentric truncated cones, except for a substantially straight cylindrical bearing. There is just enough smoothing at the junctions of the cones to prevent a sharp edge.

✦ ✦ ✦

A DIE which is worn oversize should be sized for the next draft not only by opening the bearing to the desired size, but the entering and approach angles should also be opened to maintain their proper lengths. This is very important, but sometimes neglected due to the extra time required.

✦ ✦ ✦

AS a general statement, **Bonzel** says **(p. III, Eng. Ed)**, "The shape of the die hole and condition of working and lubrication should be so adjusted that

Fig. 7. Shaper used for making laps or needles for working shape dies. ✦ ✦ ✦ ✦

pressure on the die walls is progressively lighter and is very light at the exit."

✦ ✦ ✦

FURTHER in this connection it may be said that it is often more desirable that the bearing will wear oversize gradually than that the approach as a whole will wear to the back of the die with small wear on the bearing until it is so far gone that in order to resize it it will be necessary to go up several drafts.

✦ ✦ ✦

IN the former instance, more tonnage may possibly be had at a given draft, but the total tonnage for the die be less due to its not being usable for each draft.

THE nature of the polish on the working surfaces of the die is of prime importance. **Thompson (loc. cit.)** calls attention to this and gives a curve showing that that an excellent polish, as compared with a moderate polish, reduces the pull required for drawing about 8% in the case of a 20% nickel steel and states that care spent in the preparation of dies is well repaid.

✦ ✦ ✦

THE finish of the wire, rod or tube surface is, of course, to a considerable degree, dependent on the degree of polish of the die surface. Also, the production per mil wear of hole size is very much dependent upon the polish. This is well shown by the following records of dies in drawing low carbon basic open hearth steel. The progressive figures for each die as shown in horizontal column 7 indicates clearly the reduced production from a rough die which has not had proper maintenance.

✦ ✦ ✦

ANOTHER important matter to be taken into consideration when die wear becomes, for any reason, rapid is that the carbide material removed from the die may become embedded in the wire being drawn. Such particles may

Fig. 8. Final polishing of shape die by hand with lap. ✦ ✦ ✦ ✦ ✦

act in effect as a cutting tool and cause more or less deep scoring in the following die or dies. The stock removed from them may, in turn, embed within the wire and do subsequent similar damage to the other dies. There is every reason why dies should be maintained with proper hole, shape, and polish. The different manufacturers stress the point and supply instructions, equipment and materials for the proper maintenance of dies. From the rough cored nib to finished die, it is customary to first rough lap with 220 grain silicon carbide, followed by 320 or 400 silicon carbide or boron carbide, and finish polishing with

	DIE I			DIE II			DIE III			DIE IV		
	Initial Size of Wire Drawn .1585″			Initial Size of Wire Drawn .159″			Initial Size of Wire Drawn .127″			Initial Size of Wire .127″		
1. Size of wire thru die	.588″	.161″	.168″	.159″	.1635″	.169″	.127″	.1285″	.131″	.127″	.1285″	.131″
2. Pounds wire drawn	184,420	561,658	744,828	158,050	338,475	341,660	90,420	280,829	372,414	94,000	280,829	372,414
3. Pounds wire drawn since previous size check	184,420	377,238	183,170	158,050	180,425	3,185	90,420	190,409	91,585	94,000	186,829	91,585
4. Change of size since start	.0003″	.0025″	.0095″	not measure-able	.0045″	.010″	not measure-able	.0015″	.004″	not measure-able	.0015″	.004″
5. Change of size since last check	.....	.0022″	.007″	.....	.0045″	.0055″	.....	.0015″	.0025″	.....	.0015″	.0025″
6. Per mil wear since start	615,000	224,000	78,400	calc. ∞	75,200	34,166	calc. ∞	186,500	93,000	calc. ∞	186,500	93,000
7. Pound per mil wear since last size production check	.....	170,000	26,160	calc. ∞	40,000	575	.....	127,000	36,600	.....	124,000	36,600

The above dies were put in work and were allowed to run until oversize. They were given the minimum amount of touching up to keep them in service until they became oversize.

pure diamond powder, or a "cushioned" diamond powder generally known as "alloy" powder.

✦ ✦ ✦

THE finest commercial diamond powder used for final polishing of die holes is of particle size ranging up to 3 microns (0.00012") diameter, sometimes designated as #7.

✦ ✦ ✦

AN experienced operator using the proper lap can put an acceptable finish on a die using diamond powder ranging up to 10 microns (.0004") dia., sometimes designated as #5.

✦ ✦ ✦

NO discussion of dies and wire drawing would be complete without some mention of the problem of lubrication or, perhaps better started, the lack of it. Bonzel devotes considerable well written space to theory and practice of wire drawing lubrication. He states that some substances entering into the composition of wire drawing lubricant are most peculiar and unexpected but that on the whole experience has resulted in adoption of compositions having a sound theoretical basis.

✦ ✦ ✦

THE whole field of lubrication was the subject of a general discussion at the Oct. 1937 meeting of the **Institution of Mechanical Engineers** in London. An American edition of the proceeding has been printed by the **American Society of Mechanical Engineers.** Of particular interest is the paper by **Bowden** on **"The Friction of Sliding Metals"** directing attention to the localized high temperatures; the one by **Goodacre,** on **"Lubrication in Wire Drawing"** in which mention is made of pressures in the wire drawing die of 5 to over 70 tons per square inch; and the papers by **Evans** and others on **Extreme Pressure Lubricants,** with special reference to hypoid gear lubrication, where the maximum stress on the gear tooth surface may reach values as high as 175 to 200 tons per square inch with rubbing and sliding velocities ranging from 0 to 1800 feet per minute. Problems presented have resulted in much study recently of lubricants containing in their composition sulphur, chlorine, phosphorous, etc., and those with various metallic elements not much used previously. Problems of extreme pressure gear lubrication are closely tied in with those of wire drawing and should in the main be capable of simultaneous solution.

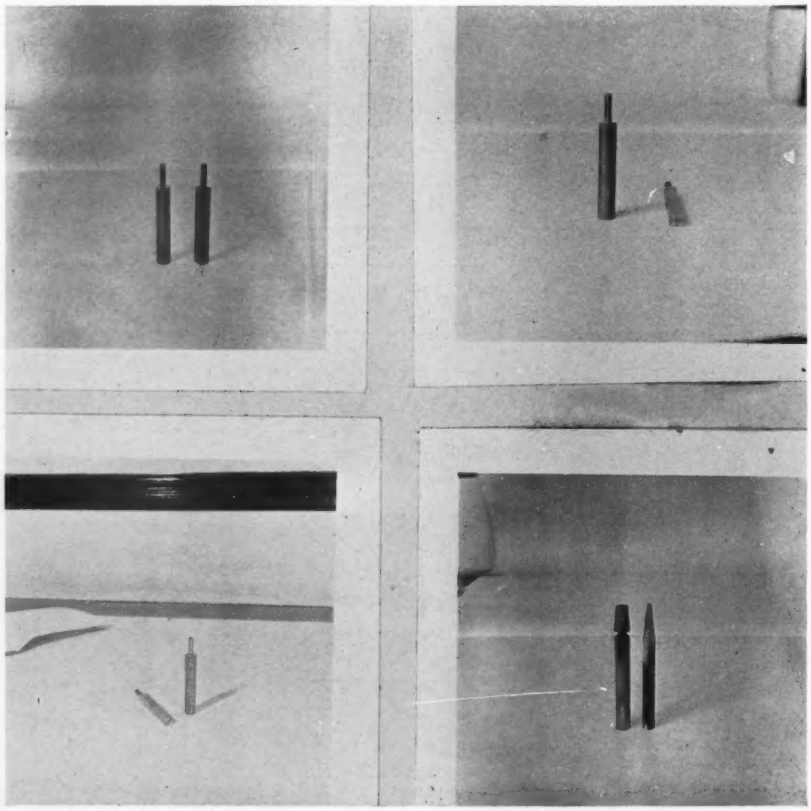


Fig. 9. Various type of laps or needles used in working shape dies. Material is cold rolled steel. Abrasive used in silicon carbide, alumina or diamond. ✦ ✦ ✦ ✦

WE are all doubtless familiar with the more or less occasional die which developes a pit in service. An examination and study of many dies leads the writer to believe that the flaking or chipping occurs in much the following steps:

1. **Lack of complete lubrication of the wire surface results in metal to metal contact at a spot in the die.**
2. **Excessive friction with heating develops at the spot.**
3. **The wire seizes and, on being pulled on through the die, leaves a piece welded to a spot in the die forming a gall.**
4. **This gall results in further highly localized friction resulting in heating, which is often evidenced by the steel casing coming to a blue heat, where it no longer supports the nib in accordance with original design.**
5. **The high local heat on the working surface of the die causes uneven thermal expansion with resultant checking of the somewhat brittle nib.**
6. **The pressure of drawing forces metal, with wedging action, into the check cracks causing a flaking.**
7. **The pit formed by the removal of the flake fills with metal from the wire and the detrimental condition is aggravated causing early failure of the die either by further flaking, rapid wear or actual breakage.**

✦ ✦ ✦

HERE we have dealt with what is primarily a lubrication failure which has made itself evident in deterioration of the die and most likely in the production of inferior wire.

✦ ✦ ✦

ANY attempt to cool the die by water or air cooling of the casing will not prevent this condition. It must be taken care of by adequate lubrication between wire being drawn and the working surface of the die.

(Please turn to Page 350)

Westinghouse Visit Features Pittsburgh Regional Meeting

THE Pittsburgh regional meeting of the Wire Association held May 5 attracted about 200 members of the association and others connected with the industry.

The committee in charge consisted of:
A. E. Glen, Assistant District Manager, Carboloy Company, Inc., Chairman.
L. M. Gumm, Mgr., Steel Mill and Metal Working Section, Industrial Sales Dept., Westinghouse Electric.
Richard E. Brown, Publisher, WIRE & WIRE PRODUCTS, Executive Secretary, The Wire Association.

✦ ✦ ✦

Wire Association Visits Westinghouse

TRIPS through that part of the **Westinghouse Electric & Manufacturing Company** at East Pittsburgh, Pennsylvania most closely associated with the wire industry featured the meeting. The greater part of one day was spent with Westinghouse as host at luncheon, an assembly lecture period, and guided tours through the East Pittsburgh and Linhart plants and the Research Laboratories.

✦ ✦ ✦

IN addition, two Westinghouse engineers, **Dr. A. A. Bates**, manager of the chemical and metallurgical division of the research laboratories, and **G. A. Caldwell**, steel mill and metal working section engineer, delivered feature addresses before the formal session of the association at the William Penn Hotel.

✦ ✦ ✦

AT the assembly in the Westinghouse plant, with **L. M. Gumm**, manager of the steel mill and metal working section, as host and chairman, the official greeting was extended by **A. C. Streamer**, newly named general manager of the East Pittsburgh division. About 75 association members were present.

✦ ✦ ✦

DR. **Phillips Thomas**, of the Westinghouse research laboratories, whose lectures and demonstrations of electrical exhibits developed by the research laboratories have become nationally known, spoke on "Adventures in Electricity."

✦ ✦ ✦

SOME of the uses of light beams were illustrated by an exhibit that automatically sorted an oversize deck of playing cards into various denominations and suits, a light beam relay that may be used as a burglar alarm and which is invisible when used with a filter attachment, and, most impressive of all, a demonstration of the Sterilamp. The latter is a lamp throwing off ultra-violet rays which will kill most germs instantly. Dr. Thomas' exhibit consisted of a slide containing paramecia in a drop of water. A microscope and projector enlarged and threw the reflection of the slide upon a large screen, which pictured the simple organisms as large as a half-dollar piece. When the light from the Sterilamp was flashed upon the paramecia, only a few seconds was required for them to die.

A. E. GLEN

Chairman, Pittsburgh Regional Meeting of the Wire Association

Entered the carbide industry in 1928. Served from 1928 to 1931 in the Carboloy Division of Cleveland Wire Works. From 1931 to present time served in the capacity of sales and service specialist on Carboloy dies. Experience includes the installation of die room equipment, training of personnel and die room layouts and analysis.

✦ ✦ ✦

SOME applications of the lamp are for protecting open wounds from germs in the atmosphere during operations, to allow meats to be preserved safely at higher temperatures in cold storage rooms because if surface bacteria are killed, decay will not ensue, and for sterilization of drinking glasses in restaurants.

✦ ✦ ✦

THE entire group visited the sections where motor coils and large turbine coils are wound and manufactured. Sections for making safety switches and railway and industrial controls were also pointed out by Westinghouse guides.

✦ ✦ ✦

AFTER lunching in the modern company cafeteria the group divided into three parts, with the larger section going to the Linhart works, where copper and aluminum are treated, and the other two parties going through other sections of the main plant and research laboratories.

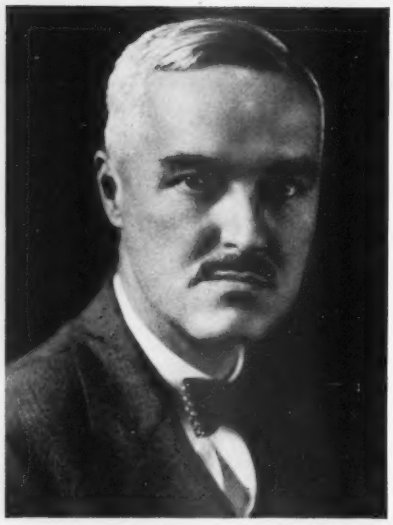
AT the **Linhart** works, the nonferrous castings are made. These include castings of pure copper and copper alloys, aluminum and aluminum alloys, all the various brasses and bronzes, bearing babbits, etc. It is here that copper wires and copper sheeting are prepared, processes of great interest to the wire men.

✦ ✦ ✦

AT the **East Pittsburgh** works, a large section is devoted to the enameling and covering of bare copper wires. The visitors were shown enamelling towers employing the modern construction method of heating and heating control. All towers are electrically heated, the heaters being placed on all four sides to obtain absolutely uniform heat distribution at each level. Here also the annealed wire and some bare wire are covered with different kinds of insulating materials. Wire insulated here is used for a multiplicity of electrical devices from magnet coils to armature and stator coils for motors and generators.

✦ ✦ ✦

AN informal dinner was held in the evening at the William Penn Hotel under the chairmanship of A. E. Glen, assistant district manager of Carboloy Company, Inc.



A. C. STREAMER

Recently named general manager of the East Pittsburgh division of the Westinghouse Electric and Manufacturing Company, who welcomed persons attending the Wire Association, to the Westinghouse plant.

MR. F. A. Westphal, Superintendent, Wire Mill, Sheffield Steel Co., Kansas City, Mo., president of The Wire Association, delivered the welcoming address. Mr. Westphal said:

"Gentlemen: At this, our Third Pittsburgh Regional meeting of the Wire Association, it is evident that it is every bit as successful as the two previous annual meetings.

It is pleasing to me to see many of our members and friends present today who also participated in our First Worcester Regional that was held last Tuesday, April 25th, at which time over one hundred members and friends participated in a program very comparable in every respect to this Third Regional meeting of Pittsburgh.

At this time I wish to express appreciation to Mr. A. E. Glenn and his associate, Ken Beardsley of the Carboloy Company, for the efficient manner in which they cooperated and cordinated with our Executive Secretary, Major R. E. Brown, in arranging this function. I, furthermore, wish to express and emphasize appreciation to the Westinghouse Electric and Manufacturing Company for the fine hospitality they extended us in the interesting tour of inspection that they made possible through their plants and departments, particularly do I wish to mention Mr. L. M. Gumm, Manager of Sales of the Iron & Steel Industrial Section of the Westinghouse Electric and Manufacturing Company.

Realizing that our technical papers are covering our phase of industry, namely wire, it has been suggested that I deviate in my message to you and express something of what might be termed patriotic importance.

I do not like repetition, but I refer you to my message at the meeting of the Board of Directors in March, and subsequently published in Wire & Wire Products, in which I emphasized a three point program, to be followed in time of war, namely (1) controlling the activities of labor by law the same as the controlling law for industry as covered by the National Defense Act; (2) the uniformity of procedure, purchase and allocation of munitions to be under one head for the purchases for the Army and Navy; (3) the tightening up with suitable legislation to give our country and the National Defense programs protection against espionage and pillaging.

In furtherance of this patriotic subject, may I express the hope that our government will be wise and understanding and take a balanced perspective, and not allow us to be led blindly or dumbly into war without an absolute just cause. As one who experienced and witnessed the horrors of war, may I say

Among the many uses of wire by the Westinghouse Electric & Manufacturing Company, East Pittsburgh, Pennsylvania, seen by persons attending the Wire Association meeting in a comprehensive tour of the plant was the making of small coils for motors. Watching this automatic coil winder are (left to right): Fred A. Westphal, president of the Wire Association and superintendent of the wire mills of the Sheffield Steel Corporation, Kansas City, Mo.; M. F. Melville, manufacturing manager, Pittsburgh Steel Company; S. A. Braley, Pittsburgh Steel Company; and E. H. Broden, manager of wire mills, American Steel and Wire Company. ✦ ✦

A visit to the Linhart Works of the Westinghouse Electric & Manufacturing Company was available to persons attending the Wire Association convention at Pittsburgh, Pennsylvania. Keen interest centered on the processing of copper wire at this plant, and here seeing the finished product spin out of the machines are (left to right): R. L. Reading, development engineer, Belden Manufacturing Company, Chicago; Harry Blount, development engineer, Western Electric Company, Baltimore, Maryland; G. L. Morris, sales engineer, Syncro-Elevator Supply Division, New York; and E. J. P. Fisher, assistant manager, Aetna Standard Engineering Company, Inc., Detroit. ✦ ✦ ✦ ✦

that war is truly horrible, and with no nation apparently the winner. I do say, however, for the protection of our homes, country and trade channels that we must be cognizant of industrial mobilization in time of war, and that we should back up this administration or any future administration on a complete and effective program of Military and Naval preparedness.

At this time, may I interject a reminder of membership. It is hoped that each of us in-so-far as possible will contact our friends who have a feasible reason for being a member of the Wire Association, and may I further state that our goal is 500 members and let's hope we will attain it within the next year or two.

As President of the Wire Association allow me to express most sincere greetings to all of you; many thanks to the efforts of the local committee in arranging this fine program; and in conclusion let us hope for the continuance and interest in these Pittsburgh Regional meetings, and lastly, that we will all meet next October in Chicago for our annual convention, at which time, I assure you, there will be a complete, effective and interesting program throughout.

Best of luck to each and every one of you, and with fond hopes of seeing you all in the near future, I thank you.

✦ ✦ ✦

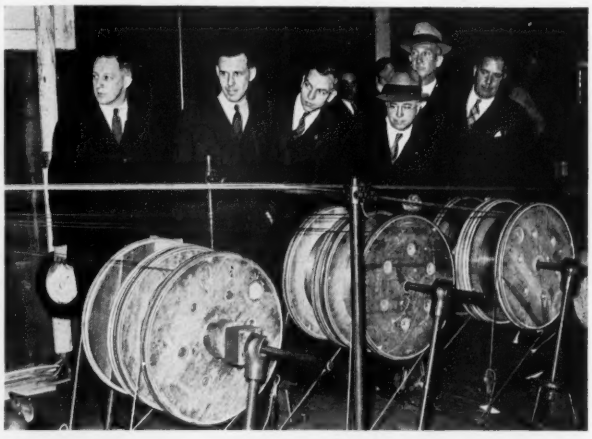
THREE technical papers were presented. 'Problems in Wire Drawing' was read by G. A. Caldwell, steel mill and metal working engineer of Westinghouse, and 'Problems Pertaining to Heat Treatment of Wire' read by Dr. A. A. Bates, manager, chemical and metallurgical division, Westinghouse Research Laboratory.

✦ ✦ ✦

THE third paper was presented by Dr. E. W. Engle, research engineer, Carboloy Company, Inc. It was on 'The Carbide Die History, Manufacturing and Use.'

✦ ✦ ✦

FOLLOWING presentation of the papers the meeting was open for an informal discussion of the above subjects.



These reeling machines in the shops of the Westinghouse Electric & Manufacturing Company at East Pittsburgh, attracted the attention of visitors from the Wire Association in recent session at East Pittsburgh. Watching the preparation of the wire for electrical uses are (left to right): A. C. Bellis, superintendent, Union Drawn Steel Division, Republic Steel Corporation; Quinton T. Martin, district industrial engineer, American Steel and Wire Company; H. L. Hopkins, metallurgist, National Screw and Manufacturing Company, Cleveland, Ohio; Harry Blount, engineer, Western Electric Company, Baltimore, Maryland; W. J. J. Shaw, foreman, Western Electric Company; and L. F. Lamplough, Western Electric Company. ✦ ✦ ✦ ✦ ✦ ✦

The processing of copper wire at the Linhart Works of the Westinghouse Electric & Manufacturing Company claimed the attention of these representatives from the Wire Association meeting in Pittsburgh as Westinghouse played host for a trip through plants processing and using wire. Watching the drawing of wire are (left to right): Joseph C. Nickels, industrial engineer, American Steel and Wire Company, Donora, Pa.; W. O. Aldrich, district industrial engineer, American Steel and Wire Company, Pittsburgh, Pa.; George A. Boswin, Stevens Metal Products Company, Niles, Ohio; E. J. P. Fisher, assistant manager, Aetna Standard Engraving Co., Youngstown, Ohio; and W. H. Solger, Aetna Standard Engraving Company, Youngstown, Ohio. ✦ ✦ ✦

THE WIRE ASSOCIATION 1939 CONVENTION

WILL BE HELD AT CHICAGO, ILL.

OCTOBER 23 - 27, 1939

In Association With The National Metal Congress

Headquarters Will Be At The Congress Hotel

✦ ✦ ✦

Plant Inspections For Members

WESTERN ELECTRIC CO.
Hawthorne Works

REPUBLIC STEEL CORP.
South Chicago Wire Mill

✦ ✦ ✦

Separate Group Meetings For The Ferrous And Non-Ferrous Divisions.

The Guest Speaker At The Annual Luncheon Will Be

Major-General Joseph A. Mauborgne, Chief Signal Officer, U. S. Army.

✦ ✦ ✦

For Full Information Address

RICHARD E. BROWN, Executive Secretary

Stamford Trust Co. Bldg. Stamford, Conn.

Carboloy Opens New Detroit Plant

Centralizing operations formerly carried on in plants located at Cleveland, Ohio, Detroit, Michigan and Stamford, Conn., the Carboloy Company formally announces the opening of its new plant at Detroit combining all previous operations at this point. This marks a radical step forward in the manufacture of cemented carbide products. ✦ ✦ ✦ ✦

ON June 1st **Carboloy Company, Inc.** formally opened its new plant and general offices in Detroit, Michigan, for the manufacture of cemented carbide products.

✦ ✦ ✦

THIS new plant, the largest cemented carbide plant in the United States, embraces a total area of 121,750 square feet. All manufacturing facilities formerly divided among **Carboloy** plants in Cleveland, Ohio; Detroit, Michigan; and Stamford, Connecticut are combined in this new plant.

✦ ✦ ✦

DESIGNED throughout for the quantity production of cemented carbides, the unusually extensive facilities of this new plant are indicative of the anticipated trend of cemented carbide use. Equipment now installed and planned for the immediate future is said to be capable of producing approximately 10 times the present amount of Carboloy currently consumed by industry. Supplementary reserve space is said to also provide for expansion considerably beyond this established potential capacity.

✦ ✦ ✦

THE plant is located on a 40 acre site situated on East 8-Mile Road, one quarter mile east of Van Dyke, just beyond the outskirts of Detroit. A two story Administration Building, with an area of 35,556 square feet, houses all general office departments such as sales, engineering, drafting, purchasing, accounting, etc. This structure is of reinforced concrete, fireproof construction, completely air-conditioned, with acoustical ceilings in halls and offices.

Administration Building

THE office building is of reinforced concrete, fireproof construction. Outside facing is red brick with limestone trim. Entranceway section is faced with decorative aluminum and limestone trim. Wall thickness is 12" with 5" air space. Office stairways have pre-cast treads of abrasive aggregate aluminum rails.

✦ ✦ ✦

Sign

THE spectacular of the word **"CARBOLOY"** extends 40 feet across the top of the general office building in letters 4 feet high. The sign is illuminated with the latest type of fluorescent tubing recently introduced, providing greatly increased lighting intensity. The outside of the sign is illuminated with daylight white, while the inside lighting is blue, a combination that achieves a brilliant, striking effect, clearly readable a mile away.

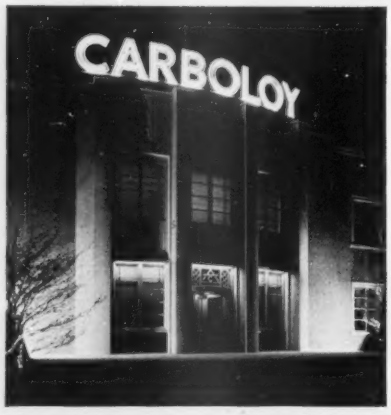


Fig. 1. A night view of the entrance to the new offices and factory. ✦ ✦ ✦ ✦

✦ ✦ ✦

Acoustics

ACOUSTICAL ceilings are provided throughout the Administration Building. These consist of perforated metal pans with rock-wool fill coated with asbestos.

✦ ✦ ✦

Partitions

OFFICE building contains masonry partitions along hallways and removable steel partitions for all offices, providing extremely flexible features for any changes desired.

✦ ✦ ✦

Interior Decoration

THE main lobby walls are surfaced with a special type of wood veneer running from ceiling to Terrazzo flooring. Walls throughout the balance of the general office building are finished in a light cream tone. Floors are surfaced with ¼" thick roll linoleum, finished in dark brown wood grain.

✦ ✦ ✦

Service Ducts

SERVICE ducts for the power and communications system are built into the floors of the general office building, accessible at any point along the lines throughout the building.

✦ ✦ ✦

Plumbing

COPPER piping is used throughout factory and Administration buildings on all hot water lines. Standard iron piping is used for all other purposes.

✦ ✦ ✦

Factory

FACTORY building is steel frame and brick construction — all welded. All service lines have been held above truss lines.

✦ ✦ ✦

Metal Room

WALLS and ceiling are lined with a 2″ thickness of insulation board backed up by rubber covered copper to keep out all dampness. Air locks are installed at all entrances. Room is completely air conditioned in order to avoid contamination of the powdered metals processed at this point. Air conditioning also essential as some of the materials are hydroscopic in nature.

Laboratories

CHEMICAL laboratory walls and ceiling are lined with a special acid resistant material.

✦ ✦ ✦

Flood Lighting

ALL sections of the grounds such as approaches, parking areas, driveways, etc., are provided with floodlighting facilities controlled at the watchman's gatehouse. Entranceway section of Administration Building is illuminated with the new type fluorescent Mazda lamps.

✦ ✦ ✦

Internal Communication System

A SEPARATE internal phone system has been provided throughout the factory and general offices. Numerous features, in addition to strictly internal communications, are provided by this system. Through its facilities the route watchmen report at various locations throughout the buildings, by dialing a special station. This automatically records the report. After a specified interval, if the watchman fails to report, the system automatically sounds an alarm. Gate watchmen also use this system for reporting. Thus, a check on both route and gate watchmen is systematically provided. The internal phone system also automatically controls signals designating factory shift periods.

✦ ✦ ✦

ADDITIONAL internal communication facilities include a paging system consisting of loud speaker announcers in the hallways of the general offices, and bell signals in the factory.

✦ ✦ ✦

Sprinkler System

ALTHOUGH all buildings are of fireproof construction throughout, a sprinkler system

Fig. 2. Air view of the new Carboloy Company plant at Detroit, Michigan. The new $750,000 general offices and factory which was opened June 1, for the manufacture of Carboloy Tools, dies and dressers. Consolidating all manufacturing facilities formerly located in Cleveland, Detroit, and Stamford, Conn., the new plant is said to have the largest cemented carbide manufacturing facilities in the United States. ✦ ✦ ✦ ✦ ✦

Fig. 3. Reception lobby of the administration building is modernly designed with wood veneer paneling and terrazzo flooring. Lighting is provided by the new fluorescent lamps giving a daylight effect. ✦ ✦

Fig. 4. All offices and hallways in the administration building have acoustical ceilings and are completely air conditioned. Offices have a unique type of offered lighting which furnishes 25 to 40 foot candles at the working plane, providing ideal working conditions. ✦ ✦ ✦

has been installed in the record rooms as an additional safeguard protecting valuable papers.

✦ ✦ ✦

Time-Saving Devices

OF interest to office managers is the "letter lift" provided to quickly transport orders, billing records, etc., between the Order Department on the first floor and the Accounting Department directly above on the second floor.

✦ ✦ ✦

Water & Materials Reclamation System

ALL water in the plant, except that used for sanitary purposes, is re-used. This includes rainwater from the roof, which is directed into the general recirculating system together with all water used for manufacturing purposes.

✦ ✦ ✦

Electrical Service

A 4600-volt primary service is received from the utility lines and transformed for factory and office use. 440 volt, 3 phase is used principally in the factory. Four individual stations located at various points in the plant for transforming to 110 volt where needed. Main switchboards provide for departmental current control and recording for all departments in both factory and general offices.

Parking Space

52,000 sq. ft. of protected parking space within the grounds have been provided for employees. Ample parking facilities for visitors are also maintained in the front of the general offices.

✦ ✦ ✦

Lighting Arrangements

OF particular interest to management executives are the unusual lighting facilities provided. Departing somewhat from conventional lighting methods, all illumination emanates indirectly from ceiling coffers 4 feet square by 15 inches deep. These provide from 25 to 40 foot candles at the working plane. A distinct-

Fig. 5. The Powder Metal Room is completely air conditioned to maintain a constant level of temperature and humidity. This permits accurate weighing and blending of materials which are hydroscopic in nature. Air conditioning also provides for the cleanliness necessary to avoid contamination of the powdered metals. A new type of fluorescent tubing provides 40-50 foot candles at the working plane. ✦ ✦ ✦

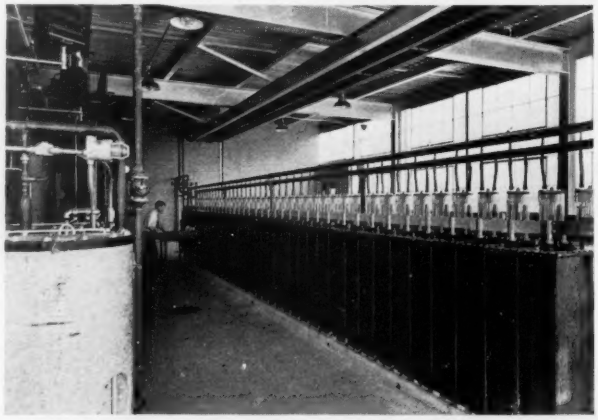


Fig. 6. Hydrogen Manufacturing Room. Special equipment for the production of hydrogen with a high degree of purification and dryness has been installed for use in all processes requiring a non-oxidizing atmosphere in the processing furnaces. Two generating units with 40 cells have a total capacity of 1250 cu. ft. per hour. Storage is provided in a spherical tank which can hold approximately 100,000 cu. ft. at 15 lbs. pressure. ✦ ✦ ✦ ✦ ✦

ive lighting effect is also achieved in the lobby and display room through the use of the new fluorescent Mazda tubes recently developed.

✦ ✦ ✦

EVEN greater light intensity is provided in the factory itself, some departments having up to 50 foot-candles at the working plane. The factory, which is connected with the rear of the Administration Building, is a monitor-type, one story, all-welded, steel and brick frame structure, covering an area of 88,197 square feet. It contains complete facilities for the manufacture of Carboloy from the raw materials through to the finished tools, dies and wear resistant parts.

✦ ✦ ✦

Research Laboratories

TO control this production, as well as for purposes of product development, a completely equipped Research Laboratory is conveniently located within the factory building. This provides for numerous functions such as particle counts of the powdered metal under magnifications as high as 3000 diameters, microscopic structure analyses of hardened Carboloy bars, chemical analyses, hardness, density and transverse rupture strength tests, special process and equipment development, and numerous other functions.

✦ ✦ ✦

THE importance of these laboratories is apparent by the fact that approximately 12 tests are conducted at various stages of production during the processing of each new "batch" of **Carboloy.** Maintenance of a sample file in which 500,000 grams of **Carboloy,** permanently identified for recheck purposes, has been accumulated to date, indicates the unusual precautions taken to control the processing.

✦ ✦ ✦

Powder-Metal Department

THE Powder - Metal Department, or "Metal Room," as it is called, is reached through air locks, installed to insure uniform operation of the air-conditioning system which closely controls atmospheric conditions in this section. Constant temperature and humidity levels are maintained here for accurate weighing and blending of the powdered metals, inasmuch as some of the materials are hydroscopic. Extreme cleanliness is also essential to prevent contamination of the powdered metals.

✦ ✦ ✦

EQUIPMENT in this department includes ball mills, crushers, sifting and mixing units. Although only one third of the Metal Room is occupied at present, equipment now installed is adequate to provide up to several million grams of Carboloy monthly. A few of the units, in fact, have an individual capacity of several times that quantity. The recently introduced 100-watt Cooper-Hewitt fluorescent tubes made especially for production precision operations, are used to illuminate this department. These provide 40 to 50 foot-candles at the working plane.

✦ ✦ ✦

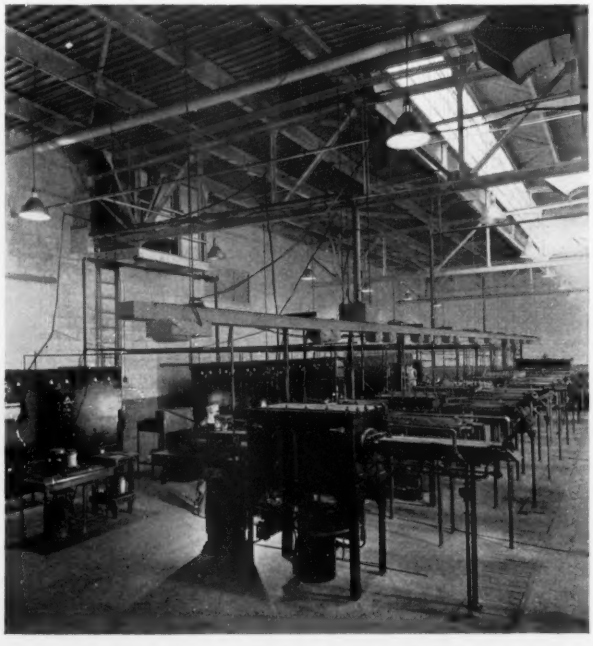


Fig. 7. The Furnace Room is equipped at present with a battery of 18 electric furnaces for reduction, carbonizing, semi-sintering, sintering and brazing processes, having a capacity of several million grams monthly. Special overhead air filter is installed to prevent contamination of powdered metals. Many of the furnaces have such features as stoking units, controlled heating and cooling cycles, etc. Control panels at left will contain temperature recording control instruments, and individual hydrogen control meters for each furnace. ✦ ✦ ✦ ✦

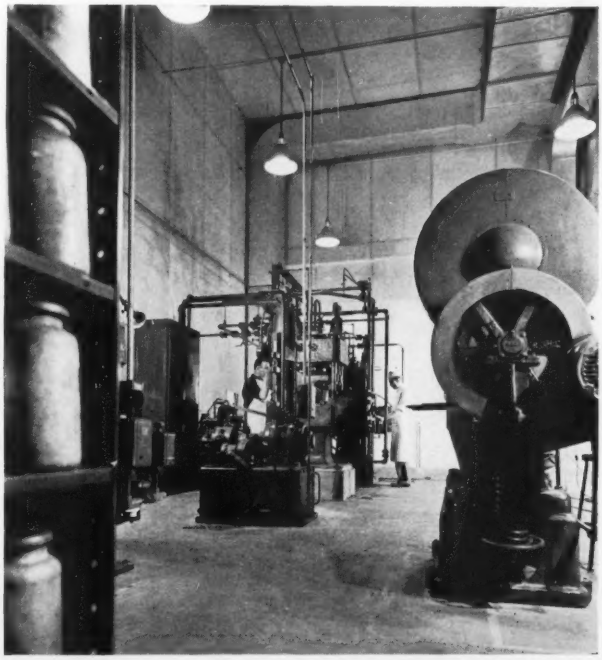


Fig. 8. Press Room. Two 300 ton presses, having a capacity of several million grams per month are used to press the larger sizes of nibs while two supplementary, continuous presses handle the smaller sizes. ✦ ✦

Metal Presses

AFTER the initial powdered metal processing the powdered metals are received in the press room, which is in a connecting wing of the "Metal Room", Two 300 ton presses, having a capacity of several million grams per month, provide for the production of ingots up to 20 square inches in area. Maximum rectangular dimensions: Length 18", width, 2", depth 1½". Additional facilities available provide for the production of larger, or unusually shaped sizes when required.

✦ ✦ ✦

TWO supplementary continuous presses with a capacity of several hundred pieces per hour — press individual pieces, such as standard round hole Carboloy Die Nibs, requiring no additional forming operations. Storage bins in this department have a capacity of 50,000,000 grams of raw and processed cemented carbide powders.

✦ ✦ ✦

Furnace Room

- Carburizing - Sintering - Brazing

QUANTITY production on all operations requiring a heating cycle is provided for by the installation of 18 furnaces for reduction, carburizing, semi-sintering, sintering and brazing processes. Supplementing these, several additional furnaces are maintained in other departments for brazing of tools and hot forging of die cases. Some of the units shown have a reserve capacity up to several million grams monthly. Quantity handling is amply provided for in many of the furnaces through such features as stoking units for semi-continuous operations, controlled heating and cooling cycles, etc.

✦ ✦ ✦

CONTROL panels adjoining the furnaces contain temperature recording control instruments, and individual hydrogen control meters for each furnace.

✦ ✦ ✦

Hydrogen Manufacturing Facilities

HYDROGEN is used for all processes requiring a non-oxidizing atmosphere in the processing furnaces. Indicative of the precautions taken to maintain the desired standard of quality and uniformity, in the installation of special equipment to produce hydrogen with a high degree of purification and dryness. Two generating units with 40 cells have a total capacity of 1250 cu. ft. per hour. Storage is provided in a spherical tank which can hold approximately 100,000 cu. ft. at 15 lbs. pressure.

✦ ✦ ✦

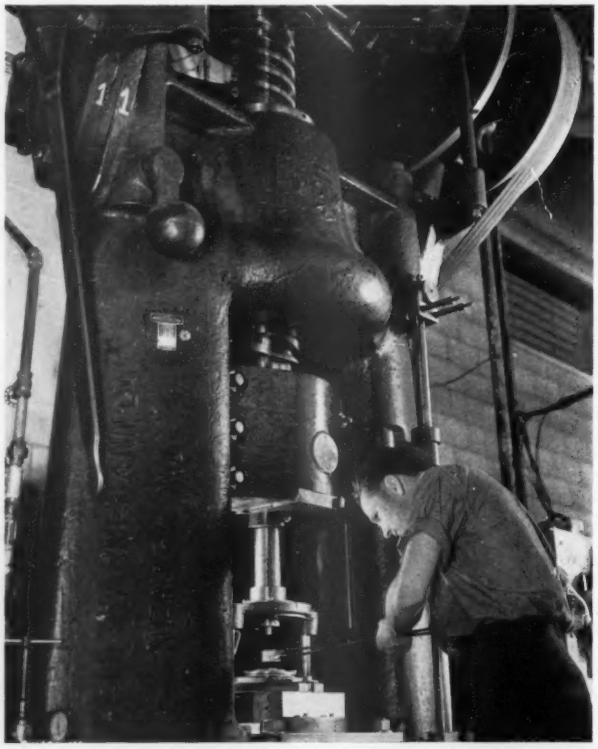


Fig. 9. In the Die Department hot forging the metal casings around the Carboloy Die nib. Two percussion presses, 250 ton and 50 ton, are installed at present for this purpose. The process provides complete support for the nib on all surfaces except at the hole through which the wire, bar and tubing pass. Internal pressure set up by the drawing operation, is balanced in this way by the external pressure of the forged casing against the nib. Casings up to 9" diameter have been handled on this equipment.

✦ ✦ ✦ ✦ ✦

Forming Department

MILLING machines, grinders, lathes, cut-off equipment and specially designed radius machines, shaped die forming equipment, etc., are employed in this department to form the rough semi-sintered ingots and special blanks into the shape desired. A wide variety of blanks, ranging from extremely thin, delicate parts to large die nibs several inches in diameter are turned out shaped and sized close to the finished dimensions.

✦ ✦ ✦

AN average stock of 250,000 grams of **Carboloy** cemented carbide is maintained in this department in the form of semi-sintered ingots and cylindrical blanks, further indicating the **quantity production** facilities embodied in this new plant.

✦ ✦ ✦

Milling Department

WHILE the **Carboloy** blank is being processed, the steel shank in which it will be brazed is being prepared in the Milling Department. Here, stock is cut to length, and recessed to accommodate the insert. Equipment such as multiple spindle milling machines, hydromatic milling machines, hydromatic milling machines with pneumatic fixtures, universal backing off lathes, screw machines, shapers, etc., provides ample facilities for **quantity production** and special production orders. Lighting, averaging 50 foot-candles at the working plane in this and other departments, provides ideal working conditions for precision operations.

✦ ✦ ✦

Grinding Department

BATTERIES of hydraulic surface grind-

ers, universal internal and external grinders, special cutter grinders, diamond lapping machines, etc., receive the **Carboloy** tools as they come from the brazing department and perform the final grinding operations necessary to produce a finished tool ready for use. Although tolerances as close as .0001" are often required on this work, adequate facilities insure rapid **quantity production** when needed for these grinding and diamond lapping operations.

✦ ✦ ✦

Carboloy Die Department

AT this point in the manufacturing process, wire, bar and tubing dies are segregated from the production of tools and other **Carboloy** products. Operations arranged for **quantity production** in this department include preparation of casing to receive the nib, rough drilling, lapping and finishing of round hole dies. Adequate facilities are also maintained for sectional and shaped die manufacture. New, specially designed machinery is now installed for practically automatic operation in the production of shaped dies.

✦ ✦ ✦

OF particular interest are the facilities for hot forging the die casings around the nib — an exclusive **Carboloy** process, one 250 ton, and one 50 ton percussion press are, at present, installed for this operation. The process provides complete support for the nib except at the hole through which the wire, bar or tubing passes. Through controlled heat treatments and selection of proper casing metals, the internal pressures set up by the drawing operations for which the dies are used, is balanced with external pressure of the casing against the nib. Casings up to 9" in outside diameter have been handled to date on this equipment.

✦ ✦ ✦

Inspection Department

A COMPLETELY equipped Inspection Department provides for routine inspection operations, such as hardness testing, visual surface examinations, specification checking, etc. For exacting inspection of intricately shaped tools and parts, such as circular and flat form tools, a projectograph, provided magnification up to 30 diameters is maintained. All of these routing inspection operations on the finished product, supplement the series of approximately 12 check-tests made at various stages of the manufacturing operation.

✦ ✦ ✦

Maintenance and General Facilities

INDICATIVE of the many economy features that have been built into this new **Carboloy** plant is the special provision for water and metal salvage. A series of covered trenches built into the floor of the plant, direct all drainage water, except that used for sanitary purposes, into a special settling tank. This water is then pumped into a cooling tower and re-circulated for use in the air-conditioning system, cleaning, and for general manufacturing purposes. The system also provides

(*Please turn to Page 336*)

Fig. 10. Grinding Department. Batteries of hydraulic surface grinders, universal internal and external grinders, special cutter grinders, diamond lapping machines, etc., receive the tools as they come from the brazing department and perform the final grinding operations. ✦ ✦

Fig. 11. Drawing & Sizing Die Department. At this point in the manufacturing process, wire, bar, and tubing dies are segregated from the production of tools and handled in this special department. Operations here include preparation of casing to receive the nib, rough drilling, lapping and finishing of round hole dies. Specially designed machinery provides for practically automatic operation in the production of shaped dies.

Exports and Imports of Wire

Export of Iron and Steel Wire Products in March 1939 and March 1938
(In gross tons)

	MARCH 1939	FEB. 1939	MARCH 1938
Wire rods	2,654	360	5,377
Strip steel	4,090	8,056	5,005
Plain, black or galvanized iron or steel wire	4,927	3,822	2,560
Barbed wire and woven wire fencing	3,768	2,135	1,706
Woven wire screen cloth	167	143	80
Wire rope	288	379	446
Insulated iron or steel wire and cable—see analysis below			
Other wire and manufacturers	577	450	451
Wire nails	1,497	1,176	1,408
Tacks	21	22	27
Other nails, including staples	351	252	245
Bolts, machine screws, nuts, rivets and washers	774	549	806
Total, these 11 classifications	19,114	17,344	18,111

Imports of Iron and Steel Wire Into the United States
(In gross tons)

Concrete Reinforcement Bars	183	162	23
Hollow bar and drill steel	134	63	92
Wire rods	821	711	369
Barbed wire	2,065	1,654	538
Round iron and steel wire	348	282	96
Telephone and telegraph wire	.....	.....	3
Flat wire and strip steel	296	166	247
Wire rope and strand	126	124	228
Other wire	155	251	82
Hoops and bands	1,867	1,670	724
Nails, tacks and staples	779	796	365
Bolts, nuts and rivets	18	6	13
Totals, these 12 classifications	6,792	5,895	2,780

Exports of Insulated Wire and Cable, March, 1939

	Foreign		To U. S. Possessions	
	Pounds	Dollars	Pounds	Dollars
Rubber covered wire	549,135	123,537	144,897	$ 26,809
Weatherproof wire	157,939	26,286	109,027	19,238
Other insulated copper wire	436,166	89,824	135,882	26,411
Nickel-chrome electric resistance wire	39,059	41,018	.....	.....
Total, these 4 classifications	1,182,299	$280,665	389,706	$ 71,458

Exports

TOTALING 162,098 gross tons valued at $12,569,693 exports of iron and steel products (except scrap) from the United States in March registered increases of 20.3 percent in quantity and 28.6 percent in value as compared with February—134,777 tons valued at $9,772,707. A year ago — in March, 1938—this trade amounted to 188,185 tons valued at $13,983,304.

✦ ✦ ✦

SCRAP exports reached their 1939 peak in March at a total of 312,262 tons valued at $4,640,598—the February trade having aggregated 224,913 tons valued at $3,345,344.

NON-ALLOY "other" plates by a narrow margin continued to be the principal product exported in point of tonnage—the 27,942-ton March total for this item including 12,950 tons dispatched to Kwantung, 3,875 tons sent to Sweden, as well as the 2,061 tons destined for the Netherlands and the 1,946 tons marked for Italy. Non-alloy black steel sheets — 27,805 tons—barely fell short of the "other" plate figure with shipments of 7,963 tons going to Russia, 2,875 tons to Canada, 2,839 tons to the United Kingdom, 2,268 tons to Chile, and 2,199 tons to Mexico. Tin plate—the month's third product as well as the third product to register a strong gain in March—went to widely scattered markets, the 16,735-ton total including 2,069 tons exported to the Netherlands, 1,893 tons sents to Brazil, 1,765 tons to French Indo-China, 1,520 tons to British Malaya, 1,461 tons to the Philippine Islands, 1,426 tons to Mexico, and the 1,336 tons sent to the Union of South Africa.

✦ ✦ ✦

CANADA topped all other foreign markets in March with her total of 15,200 tons (including 2,875 tons of non-alloy black steel sheets, 1,971 tons of plain structural shapes and 1,413 tons of non-alloy hot-rolled strip). Kwantung ranked second with a total of 13,835 tons including the 12,950 tons of "other" plate noted above. Exports to the Philippine Islands aggregated 12,787 tons with purchases of "other" steel bars amounting to 3,423 tons and tin plate 1,461 tons. Brazil's receipts —11,218 tons—included 2,799 tons of heavy rails and 1,893 tons of tin plate, while the 9,745-ton trade with Japan was made up chiefly of the 5,424 tons of non-alloy ingots and the 1,009 tons of "other" steel bars sent that country during the month.

✦ ✦ ✦

Imports

IMPORTS of iron and steel products (scrap excepted) — 24,589 gross tons valued at $1,478,663—were sharply increased over the 17,736-ton ($1,236,673) trade of February. This trade in March, 1938, amounted to only 11,600 tons valued at $989,755.

✦ ✦ ✦

AT 24,589 tons valued at $1,478,663 imports of iron and steel products were 38.7 percent larger in quantity and 19.6 percent higher in value in February. Structural shapes—3,865 tons—was, in point of tonnage, the principal product imported in March, this total including 3,091 tons received from Belgium and 715 tons which came from France. Pig iron receipts, six times as large as in February, totaled 3,658 tons including 2,714 tons from the Netherlands, 800 tons from British India, and 144 tons from Canada.

Norway — 1,168 tons — was the chief source of the 3,307 tons of ferromanganese imported in March, with 931 tons coming from Poland and Danzig, and 745 tons from the Netherlands. Canada provided 2,032 tons of the 2,176 tons of spiegeleisen which entered the United States during the month, while Germany was the source of 1,452 tons and Belgium of 546 tons of the 2,065 tons of barbed wire received.

✦ ✦ ✦

BELGIUM was the chief source of iron and steel imports in March with a total of 6,871 tons including 3,091 tons of structural shapes and 1,348 tons of "other" hoops and bands. Second place went to Germany whose total of 4,537 tons included 1,452 tons of barbed wire and 1,182 tons of "other" pipe. Pig iron — 2,714 tons — was the chief product in the 3,516-ton trade with the Netherlands, while spiegeleisen made up 2,032 tons of the 2,363-ton Canadian total.

✦ ✦ ✦

Miscellaneous Imports and Exports

CARD CLOTHING: 25,236 square feet, $38,599 (29,036 square feet, $45,052), principally from United Kingdom, 22,067 square feet, $32,936 and Belgium 2,196 square feet, $3,444.

✦ ✦ ✦

WIRE CLOTH AND SCREENING: 83,226 square feet (42,286 square feet) including that received from the Netherlands, 57,804 square feet and Germany, 18,967 square feet.

✦ ✦ ✦

WIRE FENCING AND NETTING: GALVANIZED BEFORE WEAVING: 42,482 square feet (72,275 square feet) all from Belgium. GALVANIZED AFTER WEAVING: 704,893 square feet (498,600 square feet)—also being supplied solely by Belgium.

FOURDRINIER: 27,672 square feet (29,027 square feet) chiefly from Germany, 16,769 square feet; and France, 6,733 square feet.

✦ ✦ ✦

WIRE HEDDLES: 621,000 pieces (220,000 pieces) with 372,000 pieces from Germany, 168,000 pieces from Switzerland, and 81,000 pieces from France.

✦ ✦ ✦

EXPORTS of iron and steel wood screws during March, 1939, totaled 20,862 gross valued at $3,335. Of this total, Mexico took 7,008 gross valued at $369; Argentina, 4,994 gross valued at $1,154; Chile, 3,264 gross valued at $361; Costa Rica, 1,184 gross valued at $180; Cuba, 1,102 gross valued at $291; Colombia, 744 gross valued at $514; Guatemala, 550 gross valued at $106; Honduras, 524 gross valued at $79;

(*Please turn to Page 336*)

MICROMETER PRECISION — MICRO-WELD — ELECTRIC WELDING

A complete portable unit machine for general purpose Butt Welding, instantly adjustable for various sizes of wire and perfectly adaptable for all wire manufacturing and fabricating requirements.

✦ ✦ ✦

THIS Welder is provided with a specially designed, sensitive limit switch, operating automatically with consistently uniform results on even the smallest sizes of wire, where reduced upset spring pressure is necessary. Tungsten contact tips are used in this switch to eliminate the maintenance and adjustment ordinarily required on copper contacts, which are customarily used for this service. By using the best material available in this equipment, positive, accurate results are secured under all conditions.

✦ ✦ ✦

Your inquries are solicited.

MODEL "E"
MICRO-WELD BUTT WELDER

Model E weighs only 50 pounds and is so simply designed that anyone can weld wires from No. 4 to No. 20 gauge with it—instantly changing from one gauge to another.

EVERY working part of the machine is enclosed and protected from dirt and corrosion from acid fumes. The only servicing that is necessary, is an occasional brushing of the dies with the wire brush which comes with the machine, and an occasional oiling with Three-In-One oil in the four oil holes which are visible on the index barrel and slides.

✦ ✦ ✦

HIGH electrical efficiency, with only 2½ KW rating at full capacity, allows light socket operation, which further increases the general utility of this adaptable Welder.

✦ ✦ ✦

FOR especially rugged service or for traveling crane mounting, this machine is also available made from high strength bronze, at no additional increase in price.

✦ ✦ ✦

Your inquiries are solicited.

MICRO PRODUCTS COMPANY — MICRO-WELD — 20 N. WACKER DRIVE • CHICAGO

As Distinctive

as Harris Tweed

as Russian Leather

a Meerschaum Pipe

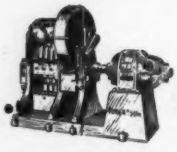
is the Performance of the

Robertson Cable

Lead Encasing Press . . .

the Robertson Hydro-

Pneumatic Accumulator

. . .  the Robertson

Hydraulic Pump. FOR DETAILS

WRITE
JOHN ROBERTSON CO., INC., 125-137 WATER ST., BROOKLYN, N. Y.

Exports and Imports of Wire

(*Continued from Page 335*)

Venezuela, 470 gross valued at $48.

✦ ✦ ✦

EXPORTS of brass wood screws during the same month totaled 2,989 gross valued at $1,079. Of this total Mexico took 1,011 gross valued at $277; Netherlands West Indies, 439 gross valued at $220; Colombia 417 gross valued at $141; Hong Kong, 265 gross valued at $126; Dominican Republic, 143 gross valued at $50; Panama, Republic of, 129 gross valued at $67.

✦ ✦ ✦

IMPORTS of wood screws during the same month totaled 49,026 gross valued at $4,597. Of this total Belgium supplied 47,251 gross valued at $4,444, and Germany supplied 1,775 gross valued at $153.

✦ ✦ ✦

Carboloy Opens New Detroit Plant

(*Continued from Page 333*)

for the periodic salvaging of powdered carbides and other metals of value that accumulate as a result of maintenance cleaning.

✦ ✦ ✦

Employee Conveniences

NUMEROUS conveniences for employees have been installed throughout the factory and general offices. These include cooled drinking fountains, large, well lighted and well equipped wash rooms, inside and outside recreational facilities and an employees' restaurant, the latter operated on a unique plan that is a happy medium between a company operated restaurant and a concession.

✦ ✦ ✦

ALL features considered, throughout general offices and factory, these new facilities leave the impression of a carefully planned step in a long range program providing not only for present requirements but also anticipated needs for many years to come.

ACCORDING to **W. G. Robbins, President of the Carboloy Company, Inc.**, the new plant, costing approximately $750,000,-00, represents an investment made to meet the quantity-production, lower-cost requirements vital to the growth of the cemented carbide industry.

✦ ✦ ✦

"This new plant," Mr. Robbins stated, "provides the facilities for developing a progressively higher order of economy, and lays the foundation for a program that should result in a more comprehensive use of cemented carbide throughout industry.

"Indicative of the anticipated trend of cemented carbide use, is the fact that this plant has facilities now installed for producing approximately 10 times the present amount of cemented carbide currently consumed by industry — and provides reserve space for expansion far beyond this established potential capacity."

✦ ✦ ✦

Carboloy Tool Manufacturing Process

BECAUSE of the rapidly increasing use of tungsten carbide tools in general industry, the manufacture of Carboloy tools will be of interest.

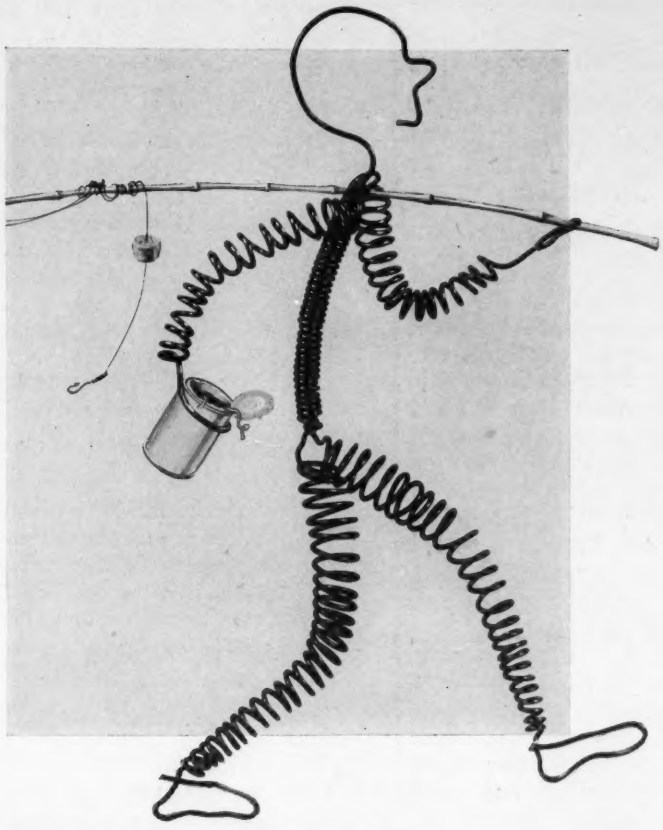
✦ ✦ ✦

FROM raw materials through to the finished tools the process may, for purposes of description, be divided into six major steps. These are, in their proper order: 1. Mixing and pressing the powder. 2. Semi-sintering or "treating." 3. Forming. 4. Final sintering or "treating". 5. Brazing the Carboloy tip to the shank. 6. Grinding.

✦ ✦ ✦

BASICALLY, tungsten is the main element in the various grades of Carboloy cemented tungsten carbide. Tungsten is manufactured directly from the ore in the plant of an affiliated company. This provides direct control of the quality and uniformity. An important feature is the fact that the tungsten ore is purchased in such quantities that one lot will last for a period of years. Each lot is thoroughly intermixed and process is adjusted, if necessary, to take care of any differences in these lots. This eliminates fluctuations caused by variables in the raw material.

(*Please turn to Page 338*)



We're Fishin' for Orders

We have some very good bait: Top-notch facilities for making wire of any analysis, specifications and finish — ability to act quickly and give you service on short notice — technical experts who can study your problems and find the right answers . . . uniformity maintained by laboratory control. If any of these things interest you, we'd appreciate a nibble.

KEYSTONE

STEEL & WIRE CO., Dept. W, PEORIA, ILL.

HIGH CARBON

or

LOW CARBON

SAMSON SPRING WIRE

Bright . . . Tinned
Coppered
Annealed
Galvanized

Davis Sparker For Testing Multiple Conductor Cable In The Stranding Operation

Output Voltage Measurement

A POTENTIAL transformer and voltmeter which *measures* continuously the voltage at the electrode and *indicates* the variation in voltage caused by the effect of the cable in the electrode is built into this sparker.

+ + +

Continuous Stepless Range Of Voltage

TO compensate for the variation in output voltage caused by the capacity of the cable under test, there is an auto-regulator built in the primary of the sparker which *varies* the secondary voltage from two to seventeen thousand volts without steps and delivers at all times the exact voltage required at the electrode.

+ + +

Continuous Indication of Output Current

THERE is built into this machine a milliammeter in the ground return of the high tension circuit which *indicates* the amount of current flowing - thus *measuring* the leakage or charging current which is going into the cable and also the amount of current which flows at a short circuit when the breakdown occurs in the cable.

+ + +

Automatic Fault Detection

THE fault current operates control relays which *stop* the strander when a breakdown occurs and lights a pilot light which *indicates* in which head the breakdown occurred and sounds an audible alarm.

R. L. Davis Electric Company

340 Center Street

Wallingford Connecticut

Carboloy Opens New Detroit Plant

(*Continued from Page 337*)

TO tungsten, is added carbon. The two elements are thoroughly mixed and then introduced into a furnace where the tungsten and carbon combine to make tungsten carbide. To the tungsten carbide is added the binder, or binders, with perhaps other carbides, depending on the grade of material being made. The mixtures are then ball-milled for a considerable period of time.

+ + +

IN the various grades, the metallic powders are so proportioned and their physical characteristics so controlled as to meet the diversified definite, in the cutting and wire drawing fields.

+ + +

Pressing

AFTER the blending or ball-milling operation, the loose powder is pressed to the shape desired by placing it in hardened steel molds and then subjecting it to high pressures in a hydraulic press. A great variety of forms and shapes are pressed in molds especially designed to meet the users' requirements. This method, supplemented by the practice of further forming the metal directly after the preliminary sintering process, (at which time the metal can be readily shaped) eliminates a large amount of subsequent grinding or shaping of the fully hardened material.

+ + +

Semi-Sintering

"SEMI - SINTERING" is the term used to define the preliminary treating or hardening which constitutes a pre-requisite to economic shaping. Semi-sintering is effected by subjecting the pressed **Carboloy** to a temperature of about 800° to 900° C. in a non - oxidizing atmosphere. Semi-sintering greatly increases the strength of the pressed material and enables it to be safely and conveniently handled while being cut, shaped or turned.

+ + +

Forming

CARBOLOY which has been properly semi - sintered is quite workable and can successfully undergo many operations. It can be cut with a saw or cutting wheel; it can be ground or shaped with an abrasive or grinding wheel; it can be worked with a file or emery cloth; it can be turned on a lathe; it can be drilled, etc. Semi-sintered **Carboloy,** in the sense of its workability, can perhaps be compared with chalk. Unlike chalk, however, the material in the semi-sintered state is quite abrasive. Because of the ease with which semi-sintered **Carboloy** can be shaped as compared with the difficulty that would be encountered in shaping after hardening, it can readily be realized that most angles or shapes can most economically be formed on the tips before the final sintering.

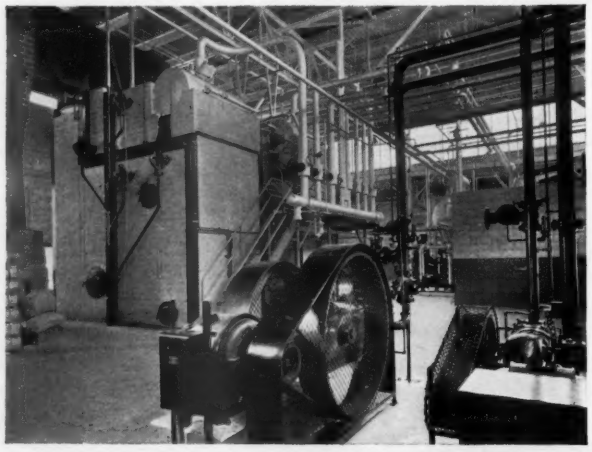


Fig. 12. Boiler Room, which provides all services such as pressure for hydraulic press equipment, high pressure air for factory, processing steam, etc. General heating is furnished by two 150 H. P. boilers, stoker fired with automatic coal feed through stokers, at 80 lb. pressure. Central dial panel is installed to give constant readings on all services and is equipped with automatic alarm system. + + + + +

CARBOLOY is reliably consistent and calculations can be made allowing for shrinkage, which will permit the hardened tip to be accurate within a few thousandths of an inch of the calculated finished size. All form tool and special tips are consequently made as near to finished specifications as possible and the amount of finish grinding necessary is, therefore, greatly decreased. On standard tool tips also, the correct angles and radii are easily formed during the tip-shaping process. Standard round hole **Carboloy** dies, which are pressed to shape in the Metal Room, require no additional forming but special dies, sectional and shaped dies are formed in this department.

✦ ✦ ✦

Sintering

THIS stage in the process is where the binder firmly cements the carbide particles together into one homogeneous solid. In most of the sintering operations the binder, or at least a portion of it, actually becomes liquid. In this hardening operation, a shrinkage of approximately 15% on all linear dimensions occurs. This final operation is quite important as warping, blistering, de-carbonization, etc., can occur if conditions are not ideal.

✦ ✦ ✦

THE temperature range at which final sintering is consummated, varies, depending on the material being treated, size, etc. In the main, the range is from 1350° C. to 1550° C. All furnace operations are carried out in non-oxidizing atmospheres. Pure Hydrogen of a high standard of quality is used at present in the production of Carboloy cemented carbides.

✦ ✦ ✦

AT every stage in the above operations, a close check is made as to quality, employing a system which permits checking back through every phase of production, even to the very source of the raw materials. Further than this, a sample of each and every lot of metal produced which makes duplication or comparison easy. This careful checking and recording method has definite advantages in the manufacture of a uniform product.

✦ ✦ ✦

Preparation of Shank and Tip for Brazing

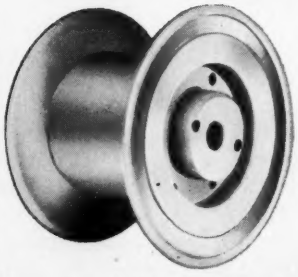
THE shank steel used is within a certain range of hardness and toughness; of characteristics which assure freedom from cracking and warping during the brazing operation, and of course is one to which **Carboloy** can be successfully brazed.

✦ ✦ ✦

IN preparing the shank, the recess for the tip is milled flat and, in general, all angles, forms, etc., are incorporated in the shank at this time. Great care is taken to eliminate any semblance of humps, etc., which would greatly reduce the support given the tip.

(*Please turn to Page 340*)

FINE WIRE HIGH SPEED WIRE DRAWING SPOOLS



James Day (Machinery) Ltd.,
Sentinel House,
Southampton Row,
London, W. C. I, England.

MOSSBERG **PRESSED STEEL** CORP.

Announces a complete line of HEAVY DUTY PRECISION SPOOLS and REELS especially designed for high speed wire drawing and annealing.

The degree of efficiency obtained by the HIGH SPEED WIRE DRAWING MACHINE is largely dependent upon the accuracy and durability of the take-up spool.

The use of our PRECISION SPOOLS will increase your machine efficiency and eliminate your spool difficulties.

Complete range of sizes.

MOSSBERG PRESSED STEEL CORP

18 West Street,
ATTLEBORO, MASSACHUSETTS, U. S. A.

COMBINATION
500 lb. CAPACITY WIRE DRAWING — ANNEALING — STRANDING — REEL.

Carboloy Opens New Detroit Plant

(*Continued from Page 339*)

The shank is then thoroughly washed in carbon tetrachloride to remove oil, grease, etc.

✦ ✦ ✦

THE **Carboloy** tip in its final hardened state is ground on all faces that will come in contact with the steel shank to assure an exact fit at these points (although as previously explained, a slight surplus is left on the outside edges for finish grinding). It is then washed in carbon tetrachloride.

✦ ✦ ✦

Attaching Tip to Shank

IN the case of a standard turning tool, a piece of very thin sheet copper is fitted to the bottom of the recess and another fitted around the side and back of the recess. The tip is then tied down by wrapping a few strands of soft iron wire around it and the shank. The shank with tip attached is dipped into carbon tetrachloride and then covered with suitable flux for brazing.

✦ ✦ ✦

Brazing

ALTHOUGH there are a number of methods in use for brazing cemented carbide tools, the use of an electric furnace with a hydrogen or non-oxidizing atmosphere gives the best results, although good results can be obtained by the torch brazing process. The temperature in the furnace is allowed to rise until the melting point of the brazing medium is reached. The tool is held for a minute or two at this temperature and is then pushed into the cooling chamber. On removal, the tool is ready for grinding.

✦ ✦ ✦

Grinding

AFTER brazing, the tools are ready for the final grinding and sharpening operations. These are performed on standard tool room equipment such as surface grinders, universal internal and external grinders, cutter grinders. Special diamond lapping machines are also employed for certain types of tools where a special finish is required. Special, soft silicon carbide wheels are of course used on all grinding of the cemented carbide tip.

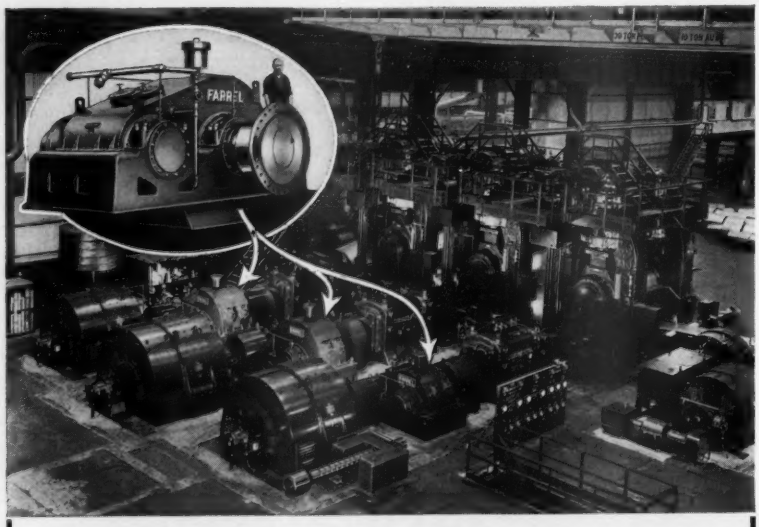
✦ ✦ ✦

D. D. Buchanan

Manager of Operations, Union Drawn Steel Division of Republic Steel Corp.

D. D. BUCHANAN who has been appointed manager of operations of the Union Drawn Steel division, Republic Steel Corp., with offices in Massillon, Ohio, has been associated with Union Drawn Steel for 15 years. Prior to 1930 he was manager of No. 3 plant at Beaver Falls, Pa., and since that time has been assistant general manager. He started with Cambria Steel Co., Johnstown, Pa., in the hot mills. Later he was connected with Jones & Laughlin Steel Corp., at Pittsburgh, and with See-Seldon, industrial engineers, Pittsburgh.

Are You Coming to The Wire Convention in October?



FARREL GEAR UNITS

Drive 84" Tandem Cold Mill at New Irvin Works

In the new Irvin Works of Carnegie-Illinois Steel Corporation the 84" three-stand tandem cold reduction mill shown above is driven by three Farrel Gear Units. Two of the stands are powered by 2500 HP motors and the third by a 3500 HP motor.

These drives are typical examples of the advanced engineering and precision construction embodied in all Farrel Gear Units to assure efficient, economical, dependable performance under the most severe operating conditions.

All three drives are single reduction units with cases of all-welded steel construction which combine greater strength with less weight. Gears are continuous tooth herringbone, accurately generated by the Sykes process. Oil is supplied to gears and bearings by a central lubricating system. Built-in sprays lubricate the gears and the bearings are flood lubricated. To prevent oil contamination, dirt and moisture are trapped by breathers mounted on the covers.

Farrel Gear Units are built in any capacity for every type of service. When you have a drive problem ask to have a Farrel engineer consult with you on your requirements.

FARREL

FARREL-BIRMINGHAM COMPANY, Inc.
ANSONIA, CONN.
New York • Buffalo • Pittsburgh • Akron • Chicago • Los Angeles

'Round the World With the Wire Industry

German Notes

THE wire industry will soon enter the market with loan issues. For three years private industry was unable to make use of the stock exchange for borrowing in the market, but now the restrictions on the small manufacturers have been abolished, it is expected that the wire industry will require at least 35 million marks (only small and medium works) for necessary works expansion and modernization. The issues will be announced the next 2-3 months. The cable industry has a particularly large need for money due to its expansion program.

✦ ✦ ✦

THE international iron and steel wire export markets have been quite active during the month. The IWECO expects, that April turnovers will exceed even the very good months of August-September, 1938. Prices are firm and only wire netting is the exception of the general firm tendency. On the markets quietness was the rule only in Argentine, Central America, the West Indies and Holland as well as Switzerland. All other markets were buying briskly. Particularly the Far East, which for many months has been marked by its inactivity. No concessions are granted at present and it is believed, that the improvement on the market will be maintained for many weeks. Shipment dates have been already extended to 8 weeks, in many cases 10 weeks. American competition is less felt at the moment.

✦ ✦ ✦

THE domestic German market continues to be very busy. Unfilled orders amount to at least 20 weeks operation at full capacity. The supplies of wire rods to manufacturers are satisfactory and contrary to many other products no rationing is necessary for this material of which the production is now some 4200 tons average per day. The export ration has been slightly increased to 6-7000 tons per month. No change of quotations is to be expected for the domestic markets.

✦ ✦ ✦

PRODUCTION of aluminum wire and aluminum cables had reached the record height of approx. 17,000 tons in 1938, which is about as much as the whole aluminum-production in 1932. This year the aluminum production in Germany will probably exceed 210,000 tons (more than all other European countries, Russia included, together) and the wire and cable production may reach 20,000 tons.

✦ ✦ ✦

THE demand for wire machinery continues to be very heavy. The turnovers of the Leipzig Fair

(*Please turn to Page 342*)

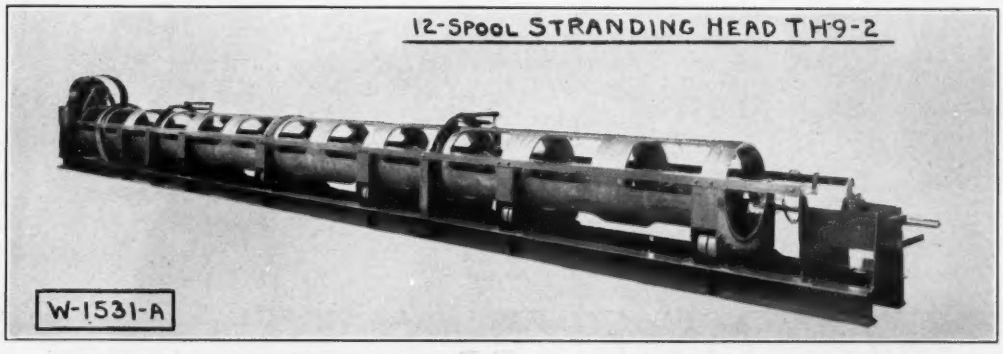
THE WATSON MACHINE COMPANY

ESTABLISHED 1845

PATERSON, NEW JERSEY, U. S. A.

TUBULAR STRANDING MACHINES

Standard Sizes For From 5 to 1000 Pound Spools
Silent Support Rolls—All Steel Rotor—Vee Belt Drive—Electric Stops



ELECTRICAL WIRE, CABLE & WIRE ROPE MACHINERY

Printed Literature Available On Considerable Of The Equipment Used In These Fields—Inquiries Are Invited

'Round the World with the Wire Industry

(*Continued from Page 341*)

are not yet definitely known and the 30 works which exhibited wire machinery or kindred machines, have been able to sell about 12% more for domestic demand than in 1937 and 4-5% more for export. Shipment dates have been extended one year. The main export demand is still from European markets, but the Latin American markets are again buying after a period of quietness. Prices for all sorts of wire machinery are maintained. Russia is buying wire machines in small quantities, but is ordering great numbers of spare parts, mainly for nail and barbed wire machinery.

✦ ✦ ✦

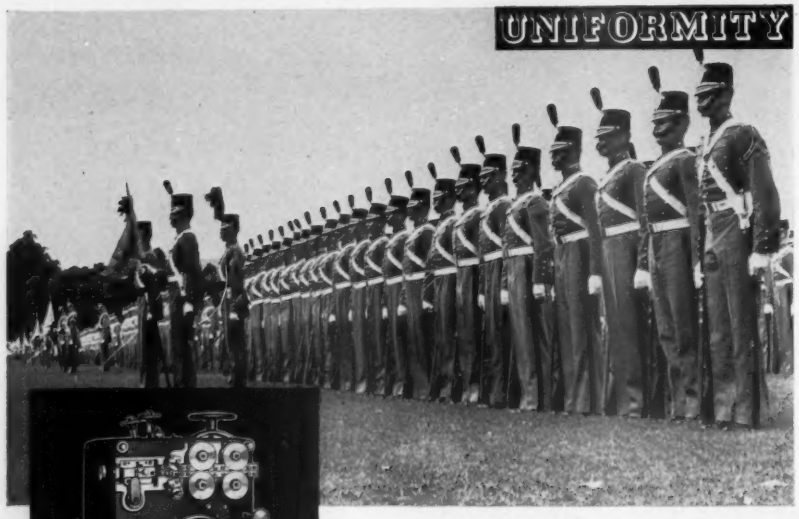
Greek Market for Horseshoe Nails

UNTIL quite recently American horseshoe nails were virtually unknown in the Greek market. Swedish nails predominated and bid far to continue to do so until, in 1937, the Greco-Swedish clearing arrangement got out of balance with Greece on the unfavorable side. Greek buyers then turned to the United States with the result that some $2,000 worth of horseshoe nails were sold in Greece in 1937. Sales in 1938 amounted to $5,500 and would have been larger except for import restrictions in force. The modus vivendi between Greece and the United States which came into effect on January 1, 1939, and which made a separate allotment of 500,000 drachmas (about $4,400) semi-annually for the specific purchase of goods included in Greek tariff item 76 (which covers all kinds of nails and screws) and while this sum is short of current demands for American horseshoe nails alone, the allotment represents a considerable increase over that of 1938 and earlier years. (Office of the American Commercial Attache, Athens).

✦ ✦ ✦

Precision Methods for Iron and Steel Fabrication

THE office of the American Commercial Attache at London reports that the Philips Industrial X-Ray Service recently demonstrated at Birmingham equipment for the X-ray examination of semi-finished hardware, metals and various engineering products. The machine they demonstrated is claimed to penetrate steel up to 2½ inches photographically and ⅜ inch visually, while in the case of castings it will penetrate to 12 inches photographically and between 3 and 4 inches visually. An additional unit can detect magnetically fine cracks and flaws in or near the surface of ferrous metals. It was also stated that the Philips Industrial X-Ray Service is a subsidiary of the well known Philips organization of the Netherlands, manufacturers of radio and X-ray equipment.



If you are interested in more and better springs per machine hour . . . springs formed to an amazingly high degree of uniformity . . springs which, because of high-speed, accurate production, will sell at a greater profit . . . then you will want to know more about TORRINGTON new, improved Spring Coiling Machines. Write for new bulletins describing and illustrating a complete range of Segment and Clutch Type Coilers and Torsion Spring Winders.

Spring Making Machines by

TORRINGTON

THE TORRINGTON MANUFACTURING COMPANY
TORRINGTON, CONNECTICUT . . . U. S. A.

A Review of Recent Wire Patents

No. 2,152,816, WIRE FENCE, Patented April 4, 1939 by Axel Olson, Parshall, N. Dakota.

More specifically, the invention lies in the provision of means to connect sections of wire fence, in fence building.

✦ ✦ ✦

No. 2,153,174, ELECTRIC CABLE, Patented April 4, 1939 by John Collard, Hammersmith, London, England, assignor to Electric & Musical Industries Limited, Hayes, Middlesex, England, a company of Great Britain.

It is claimed that the construction of this cable is such that interference is reduced or eliminated over a large frequency range, by the provision of an auxiliary conductor with a conducting sheath of lead surrounding this conductor.

✦ ✦ ✦

No. 2,154,149, APPARATUS FOR FORMING SPACING BENDS IN WIRE FABRIC, Patented April 11, 1939 by Alexander Chambers, Monessen, Pa., assignor to Pittsburgh Steel Company, Pittsburgh, Pa., a corporation of Pennsylvania.

This appartus will provide spacing bends in either the strand or the stay wires, the bends being stretched and cold-worked.

✦ ✦ ✦

Complete Descriptions and Drawings of Patents May Be Had for 25 cents. Address, Wire & Wire Products, 300 Main St., Stamford, Conn.

No. 2,154,530, SCREEN CLOTH AND METHOD OF MAKING THE SAME, Patented April 18, 1939 by Samuel Davis Robins, Hewlett, N. Y., assignor to Robins Conveying Belt Company, Passaic, N. Y., a corporation of N. J.

It is stated that this wire screening is particularly applicable for use in screening hard, abrasive materials, such as gravel, stone and the like.

✦ ✦ ✦

No. 2,154,551, FLEXIBLE STRANDED CONDUCTOR, Patented April 18, 1939 by Hans V. Wodtke, Marion, Ind., assignor to Anaconda Wire & Cable Company, New York, N. Y., a corporation of Delaware.

Bending of one wire strand on another and friction between strands is avoided or largely eliminated, it is stated.

✦ ✦ ✦

No. 2,155,095, ELECTROWELDING OF WIRE NETTINGS, Patented April 18, 1939 by Wilhelm Kramer, Emmerich, Rhine, Germany.

The machine is provided with one or more eccentric discs, by means of which the guide bars for the longitudinal wires may be reciprocated in the transverse direction relative to the electrodes, or conversely.

✦ ✦ ✦

No. 2,155,243, ELECTRICAL CABLE, Patented April 18, 1939 by Moyer M. Safford, Schenectady, N. Y., assignor to General Electric Company, a corporation of New York.

About the wire conductor is an insulation of heat resisting material, such as asbestos or spun glass, about which is a jacket of water-resistant, heat-resistant and flame-resistant synthetic resinous composition, such as a plasticized polymerized vinyl halide, with a covering therefor of metallic tape.

✦ ✦ ✦

No. 2,155,310, NAIL MAKING MACHINE, Patented April 18, 1939 by José de Jesus Hernandez, Guadalajara, Mexico.

A single hammer is provided, which will produce a number of nails with a single impact, a number of wires being fed into position at the same time.

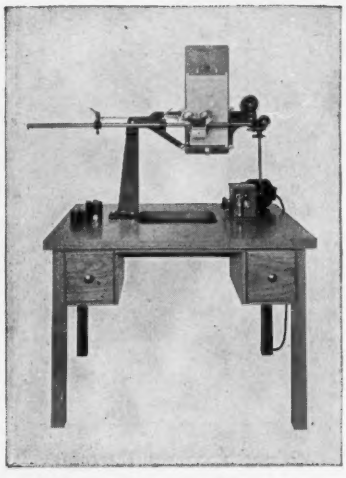
✦ ✦ ✦

No. 2,155,403, METHOD OF MAKING INSULATED WIRE, Patented April 25, 1939 by William E. Cook, New York, N. Y.

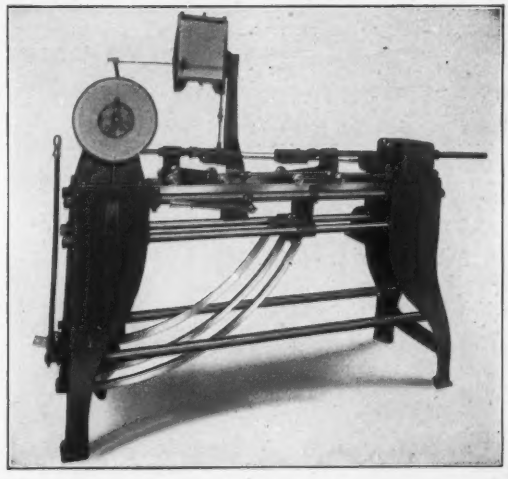
The wire is passed vertically through an asphaltum bath of high melting point

(Please turn to Page 344)

SCOTT TESTERS



Model IP-2
Maximum capacity
2 pounds



Model Q-5
Maximum capacity
2000 pounds

AUTOGRAPHIC recording tensile testing machines built on either the constant specimen rate of load or constant speed of pull principles. Made in a wide range of models and capacities with high and low stretch magnification recorders - for Wire, Sheet Metals, Rubber, Textiles, Paper, etc.

We are exhibiting some of our equipment at the
A.S.T.M. Convention in Atlantic City the week of June 26-30.

HENRY L. SCOTT CO.

P. O. BOX 963 PROVIDENCE, R. I.

A Review of Recent Wire Patents

(Continued from Page 343)

and after excess compound is removed, is chilled. A dam stratum of non-deformable material is applied to the chilled stratum, and then laying an outer fibrous material upon the dam stratum, with the fibrous material impregnated with an asphaltum compound of lower melting point.

✦ ✦ ✦

No. 2,155,405, ELECTRICAL CONDUCTOR, Patented April 25, 1939 by Donald K. Crampton, Marion, and Henry L. Burghoff, Waterbury, Conn., assignors to Chase Brass & Copper Co. Incorporated, Waterbury, Conn., a corporation.

Characteristics of this conductor are said to be its high electrical conductivity and high tensile strength. It is formed of a copper base alloy containing: nickel from about 0.25% to about 3%; phosphorus from about 0.05% to about 0.6% and the ratio of the nickel to phosphorus being from about 3.5 to 1 to about 7 to 1; and copper; the copper, nickel and phosphorus constituting 93% or more of the alloy.

✦ ✦ ✦

No. 2,155,406, ELECTRICAL CONDUCTOR, Patented April 25, 1939 by Donald K. Crampton, Marion, and Henry L. Burghoff, Waterbury, Conn., assignors to Chase Brass & Copper Co., Incorporated, Waterbury, Conn., a corporation.

This differs from the above in that alloy contains; iron from about 03% to about 3%; phosphorus from about 0.1% to about 0.6% and the ratio of iron to phosphorus being from about 2.5 to 1 to about 5.5 to 1; metal selected from a group consisting of tin and zinc, the tin not exceeding about 1.5% and the zinc not exceeding about 10%, the total per cent of tin and/or zinc being such that the

$$\frac{\%\ \text{tin}}{1.5} \text{ plus } \frac{\%\ \text{zinc}}{10}$$

is from about 0.05 to about 1; and the combination of high electrical conductivity and high tensile strength being due primarily to the combined effect of the iron, phosphorus, tin and/or zinc, heat-treatment and cold-working.

✦ ✦ ✦

No. 2,155,407, ELECTRICAL CONDUCTOR, Patented April 25, 1939 by Donald K. Crampton, Marion, and Henry L. Burghoff, Waterbury, Conn., assignors to Chase Brass & Copper Co., Incorporated, Waterbury, Conn., a corporation.

In this patent, the alloy contains: nickel from about 0.25% to about 3%; phosphorus from about 0.05% to about 0.6% and the ratio of the nickel to phosphorus being from about 3.5 to 1 to about 7 to 1; metal selected from a group consisting of cadmium, tin and zinc, the cadmium not exceeding about 1.5%, the tin not exceeding about 1.5% and the zinc not exceeding about 10%, the total per cent of cadmium and/or tin and/or zinc being such that the

$$\frac{\%\ \text{cadmium}}{1.5} \text{ plus } \frac{\%\ \text{tin}}{1.5} \text{ plus } \frac{\%\ \text{zinc}}{10}$$

is not greater than about 1; and copper; the copper, nickel, phosphorus, cadmium and/or tin and/or zinc constituting 93% or more of the alloy.

No. 2,155,792, SPRING CUSHION, Patented April 25, 1939 by Gustave P. Johnson, Waukegan, Ill.

A section of wire netting is cushioned by helical wire springs the arrangement being such that the lower convolutions of the spring can be readily rotated into position between said upper and lower strand portions without requiring deformation of the spring convolutions or of the strand portions.

✦ ✦ ✦

New Standards Announced By NEMA

THE **National Electrical Manufacturers Association** announces the release of two new Standards as follows:

NEMA Fan Standards, Publication No. 39-56.

NEMA Manufactured Electrical Mica Standards, Publication No. 39-55.

✦ ✦ ✦

THE Fan Standards cover desk and bracket, ceiling, ventilating, and air-circulator types and include information on ratings, performance requirements, general guarantees, and manufacturing practice. Copy of this Standard may be obtained from NEMA Headquarters for $.10 a copy.

✦ ✦ ✦

THE Manufactured Electrical Mica Standards, Publication No. 39-55, supersedes an old publication numbered 33-18 which was printed in 1933. The new publication contains the following information:

Standard Classification of Muscovite Mica Splittings.

Standard Classification of Phlogopite (Amber) Mica Splittings.

Standard Composition, Tolerances and Properties of Manufactured Mica Sheets and Wrappers.

Dimensions of Standard Sheets.

Standard Composition, Tolerances and Properties of Manufactured Mica Tubes.

Standard Average Tolerances for Manufactured Rings.

✦ ✦ ✦

COPY of the Mica Standards may be obtained from NEMA Headquarters at $.25 a copy.

✦ ✦ ✦

L&N Catalog for Apparatus for Electric Conductivity Apparatus

A NEW 40-page illustrated catalog on "Apparatus for Electrolytic Conductivity Measurements in Laboratory and Plant" describes and lists the latest forms of L&N apparatus for making all well-established electrolytic conductivity measurements. It contains a general discussion of research, routine and industrial measurements and includes information on recent developments in technique and apparatus for precise measurements. As a guide in assembling appropriate groups of apparatus for research, general laboratory use, routine testing and educational work, suggested combinations of equipment are illustrated and listed.

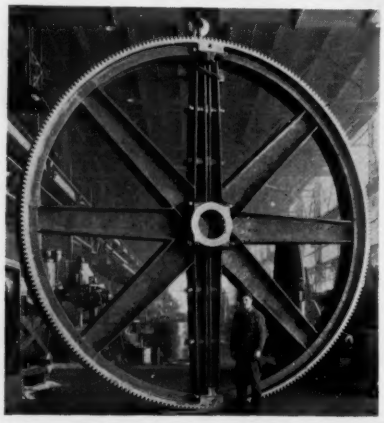
✦ ✦ ✦

TO receive a copy, ask Leeds & Northrup Company, 4934 Stenton Avenue, Philadelphia, Pennsylvania, for Catalog EN-95.

✦ ✦ ✦

Eighteen-Foot Gear for Rolling Mill Drive

THE Farrel-Sykes continuous tooth herringbone gear, shown in the accompanying illustration, is over 18 feet in outside diameter, with a 25-inch face. The total



weight of the two steel castings from which the gear is made is 44,900 lbs. The two halves are carefully machined and bolted together with fitted bolts. The teeth are accurately generated by the Sykes process. The gear was made by Farrel-Birmingham Company, Inc., Buffalo, N. Y., for driving a rolling mill. It transmits 800 H. P. at 360 R. P. M. The ratio of the gear and pinion is 18.12/1, the speed of the gear is 19.85 R. P. M. and its peripheral velocity, 1130 feet per minute.

Visit of the Wire Association to The Norton Company

(*Continued from Page 317*)

removal, as in the snagging of billets and castings, and is characterized by a certain smoothness of action. On camshafts and ball-bearing races a high quality of finish is obtained with rubber bonded wheels. Rubber cut-off wheels make rapid and economical cuts at both high and low speeds, and may be made thin enough to reduce to a minimum the material lost in making the cut.

✦ ✦ ✦

SHELLAC bond is also an organic bond, which is capable of imparting high finishes to camshafts and steel mill rolls. It is not intended for heavy duty, being confined more to operations on which stock removal is slight.

ALL grinding wheels are made up of three elements—abrasive grain, bonding material and pores. The first is the working element, the second determines the grade, and the third represents the voids between the grains.

✦ ✦ ✦

A NUMBER is used to designate the size of the individual abrasive grains in the grinding wheel. This number corresponds to the meshes per inch in the screens used in sizing the grains. Careful grain sizing is important, in order that each abrasive particle in the grinding wheel may act as an efficient working unit.

✦ ✦ ✦

AS has already been pointed out, the abrasive grains in a grinding wheel are held in place by posts of bond. If these bond posts are very strong and are capable of holding the grains against the considerable force tending to pry them loose, the wheel is said to be of a hard grade. On the other hand, if only a small force is needed to release the grains, the wheel is said to be of a soft grade.

✦ ✦ ✦

IN the Norton method of marking wheels, as in most methods, the grade letters increase in "hardness" from E to Z.

✦ ✦ ✦

THE third element in a grinding wheel, after abrasive and bond is the "pores". These are the voids between the grains and bond posts, and are dependent for size and number upon the spacing of the abrasive grains throughout the wheel body. In Norton grinding wheels, the word "structure" is used to indicate this abrasive spacing.

✦ ✦ ✦

IT is apparent that grinding action must be affected materially by the spacing of the abras-

(*Please turn to Page 352*)

IN THIS BOOK
Clippers to cut steel as thick as your thumb — big powerful tools for heavy wrecking jobs. In-between sizes to fit every need. Special tools for cutting cable, flat stock, etc. Swivel head models — the "wrist action" tools which reach around corners at all angles. This catalog covers the entire Porter line. Tells about hardness of metals and the right cutting tools. It is yours for the asking.
PORTER Cutters
For the wire working industries Porter Cutters with round edge jaws cut all types of wire and stand up under long continuous use. For certain wire cutting a Porter Shear Cutter serves best while for small spring wire a Porter Bench Cutter is a time and money saver. Special jaws designed and produced to meet individual cutting problems. No tool has more general uses than a standard Porter Clipper—for speed in production work a special Porter tool may be advisable. Send your problems along to us.
The Bolt Clipper People
EST. 50 YEARS
H. K. PORTER, INC., 19 Ashland St., Everett, Mass.

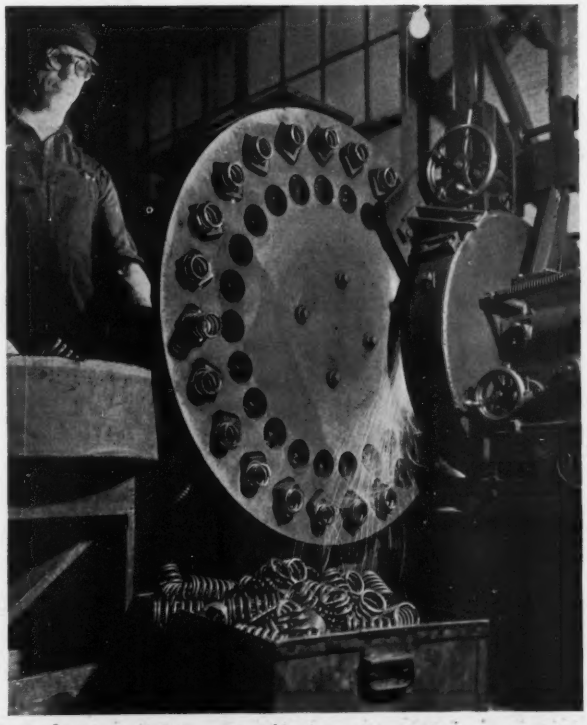
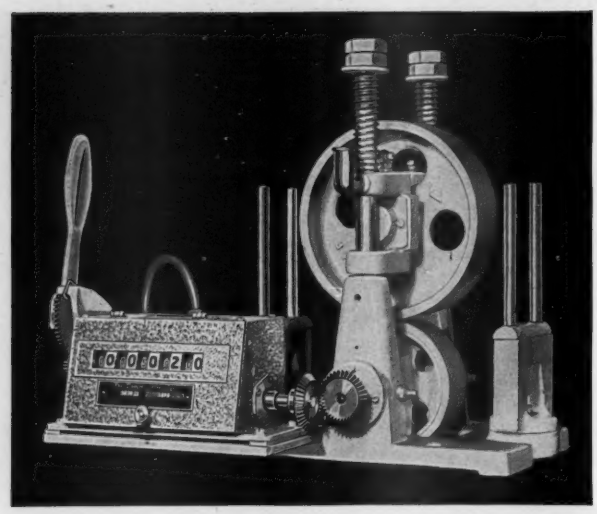


Fig. 3. Grinding Springs with Disc Wheels.

✦ ✦ ✦



Now a

Wire Measuring Machine for Every Purpose

The recent addition of several new models enables us to offer wire and cable manufacturers and users, machines for the fast, accurate lineal measurement of any kind of bare and insulated wire, twisted pairs, wire rope and lead-covered or armored cable. Capacities .005" dia. and up.

Write for bulletin giving description and prices of Productimeter Wire Measuring Machines and Braiding Machine Counters.

DURANT MFG. CO.

1918 N. Buffum Street
Milwaukee, Wisconsin

176 Eddy Street
Providence, Rhode Island

Heat . . . circulate . . . agitate your pickle liquor with DURIRON STEAM JETS

Rapid heating saves time and steam . . . complete circulation means **all** parts are cleaned equally . . . an **active** solution saves acid, assures better results. Write for Bulletin 1801 which contains complete data and a chart for figuring steam requirements for any size tank.

Duriron for sulphuric . . . **Durichlor** for muriatic.

The Duriron Co., Inc.

445 N. Findlay St. Dayton, Ohio

Problems in Wire Production and Use

(*Continued from Page 315*)

on each block and by proper synchronization of these motors, it is not necessary to accumulate wire on any one block and only a few turns of wire is required around each block. These machines require D.C. motors which can have their speeds adjusted to one another at any given ratio and in addition they are usually designed to take care of different sizes and different types of wire which require different drawing speeds.

✦ ✦ ✦

THE motors on these machines must all be started and accelerated at the same rate in order to control the amount of loop between the blocks as the wire would be broken if all of this loop was taken up. The motors must be designed for smooth acceleration and yet designed for a very rapid stop in case of breakage of the wire or for the sake of safety should an emergency condition arise. Even though the delivery speed of this wire may be as high as 1500 or 1600 feet per minute, it is possible to stop the machine in one or two revolutions of the block.

✦ ✦ ✦

IN most cases the large tandem wire drawing machines are used as the basic production unit for the initial breakdown of the wire after it comes to the wire mill from the rod mill. Therefore the machine along with its electrical equipment must be of the best quality to insure continuous operation. With the development of welding together of the ends of the rods of each bundle, threading of the machine has been practically eliminated and the machine is never stopped except to remove a bundle of wire and re-threading is not required except in cases of breakage of the wire while going through the machines.

✦ ✦ ✦

ALTHOUGH, as previously indicated, there is a wide variety

of wire drawing machines, probably the largest and most interesting and involving the more complicated electrical equipment are these large single block and tandem machines. Several typical machines on which we have supplied electrical equipment are shown in the accompanying photographs.

✦ ✦ ✦

WE hope that our comments on some of our special uses and application of wire and also on the various types of electrical equipment required for wire drawing machinery show that we really have a very deep interest in the wire drawing industry not only in getting special wire for our application but also in producing special electrical equipment designed for use on the wire drawing machines.

✦ ✦ ✦

Scovill Licensed to Make New Product

THE Scovill Manufacturing Company, brass manufacturers of Waterbury, have just recently closed a licensing agreement to make the Phillips Recessed Head Screw, a comparatively new development which is said to employ a principle which makes possible much faster assembly work than with slotted screws.

✦ ✦ ✦

MANY nationally-known manufacturers of motor cars, aircraft, electrical appliances and various wood and metal products are said to be employing this new type screw.

✦ ✦ ✦

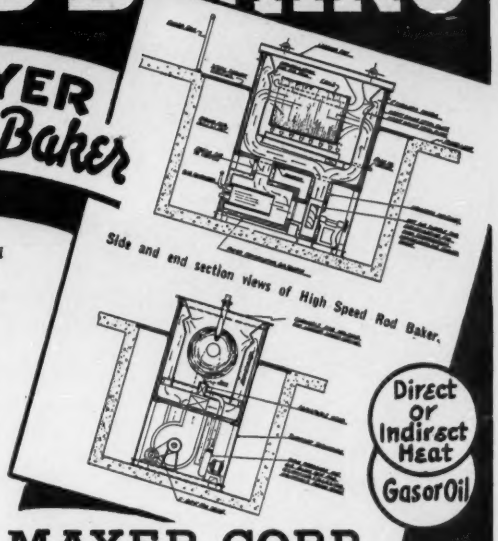
AT the recent auto show in New York, it was conservatively estimated that two out of three of the new models use Phillips Recessed Head Screws on door hinges, window mouldings and other screw-fastened parts. Such famous aircraft as the new Boeing Atlantic Clipper and the Douglas DC-4 are said to be employing Phillips Screws in their assemblies. The Phillips Screws are also widely used in washing machines.

The Wire Association Convention Will Be Held At Chicago, Ill., October 23 - 26, 1939

It will "show you something" in **ROD BAKING**

CARL-MAYER "Hi-Speed" Rod Baker

Patents Allowed and Patents Pending



Side and end section views of High Speed Rod Baker.

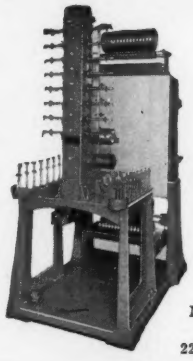
It is backed by 20 years' experience and a reputation for advanced engineering and dependability in industrial oven construction . . . Write for literature today.

Direct or Indirect Heat Gas or Oil

THE CARL-MAYER CORP.

ROD BAKERS ~ OVENS ~ AIR DRAW FURNACES

3030 EUCLID AVENUE ◇ CLEVELAND, OHIO



AIMCO R-16 MODEL WIRE ENAMELING MACHINE

Enamels Wire 36 B. & S. Gauge and Finer.
Electrically Heated Oven with Thermostatic Control.
Finished Wire Spindles Individually controlled.
Traverse is Adjustable for Different Spool Dimensions.
Low Cost of Enameling Wire is Due to Ease of Operation and Number of Spindles one Operator can tend.
Self-Contained on Bed-Plate.
Motor Driven.
Motor included.

EST. 1885 AIMCO INC. 1913

"American" INSULATING MACHINERY COMPANY

REG. U.S. PAT. OFF.

New England Sales Representative: SIDNEY B. BLAISDELL 228-232 Aborn St., Providence, R. I.

517 West Huntingdon St. PHILADELPHIA PENNSYLVANIA U.S.A.

STEEL WIRE

By MAURICE BONZEL

Translated and Published by Kenneth B. Lewis, Consulting Engineer

Price $15.00

495 pages. 414 charts, photomicrographs and illustrations

SEND ORDERS TO

WIRE and WIRE PRODUCTS

Stamford Trust Co. Bldg. Stamford, Conn.

PICKLE WITH
RODINE
WORLD-WIDE
INHIBITOR

Just a little RODINE in the pickling bath saves metal, saves acid, saves fuel, prevents embrittlement, keeps down acid spray, and gives better pickling—at less cost. Write for Bulletin 13-L.

If you have any metal-treating problem—pickling, cleaning, rust-proofing under paint — we will gladly work with you to solve it.

American Chemical Paint Co.
Box 306, AMBLER, PENNA.
Detroit, Mich. Walkerville, Ont.

Metallography in the Wire Industry

(*Continued from Page 309*)

Heat Treating

DURING the heat treating for oil tempered wire the effects of extreme high or low quenching temperatures may be checked with the aid of microscopic examination of the oil quenched product. Extremely low heats will result in very little carbide absorption and a study of the structure will reveal a relatively large percentage of undissolved carbide as indicated in Fig. 21. Extremely high heats will result in a large needle-like structure indicated in Fig. 22. This structure may prove undesirable. Fig. 23 illustrates a very fine structure developed in tempered wire.

✦ ✦ ✦

Fig. 21. Underheated Steel Wire. (Oil Tempered). Magnified 500 X. ✦ ✦ ✦

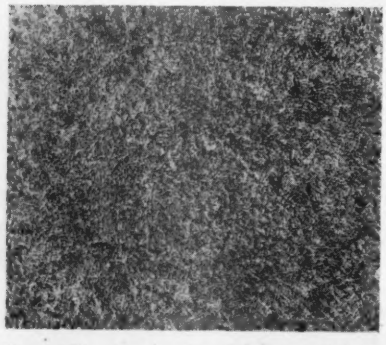


Fig. 23. Fine Structure in Oil Tempered Wire. Magnified 500 X. ✦ ✦ ✦

Dies for
High Speeds
Long bearing Dies
Short bearing Dies
Special bearing Dies
FAMOUS
WIRE DRAWING DIAMOND DIES
VIANNEY
250 E. 43rd St. • New York
Largest Stocks in U.S.A.
Quickest Deliveries
Safest Guarantees
Best Selections
Lowest
Costs

STEEL REELS
AND DRUMS
for
WIRE AND CABLE
INDUSTRY
R.B. HAYWARD CO.
1714 Sheffield Ave. Chicago, Ill.

WHOEVER
UNDERSTANDS
GERMAN
Should Read
'Draht-Welt"
(Wire World)
A weekly for the wire industry and related lines.
Subscription price: Rm. 6.50 quarterly
Sample copies free on request from:
Martin Boerner — Verlag
Halle — Saale
Germany

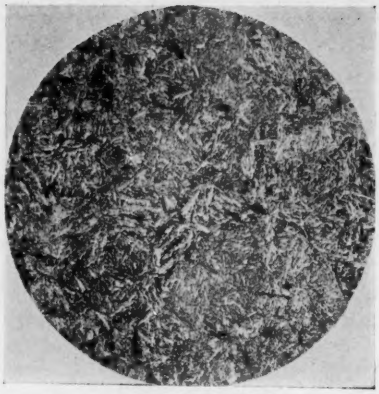


Fig. 22. Coarse Structure in Oil Tempered Wire caused by high Quenching Temperature. Magnified 500 X.

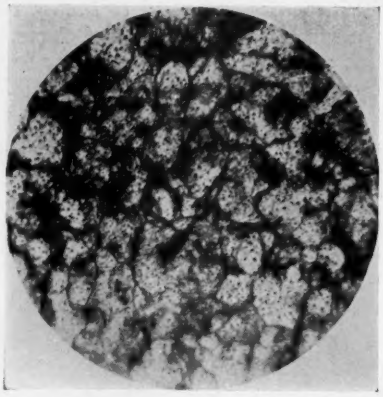


Fig. 24. Hardened Steel Etched to Develop Austenitic Grain Size.

THIS discussion of the use of the microscope in the wire industry was intended for the beginner and for the individual who has not had an opportunity to use the microscope but who is keenly interested in learning more about his product. The microscope has served to enlighten many a wire maker and it can continue to improve our knowledge of the nature and behavior of such a complex product as a bundle of wire.

Manufacturers of materials, tools and equipment for wire drawing and forming plants are constantly making improvements and additions to their lines. If you do not find the product or service in which you are interested, additional information will be supplied promptly. Simply address:

WIRE & WIRE PRODUCTS
300 Main St. Stamford, Conn.

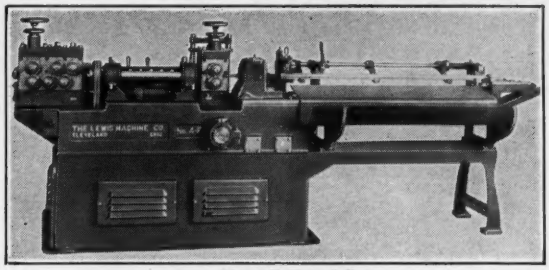
DIAMOND POWDERS MAY LOOK ALIKE — BUT THE MICROSCOPE SHOWS A DIFFERENCE —

SMIT Diamond Powders are graded in sizes from No. 1 to No. 6 by a particle size analyzer so that the fragment sizes are uniform and perfectly adapted to the work for which they are selected.

—— We Invite Your Inquiries ——
Fine Raw Material — Uniform Size — Sharp Cutting Grains

J. K. SMIT & SONS, Inc.
157 Chambers St., N. Y. C.
968 Farmington Ave., Hartford, Conn.
605 Law and Finance Bldg., Pittsburgh, Pa.

LEWIS Wire Straightening and Cutting Machines
— Automatic—High Speed—Heavy Duty —



No. 4-F Travel-Cut

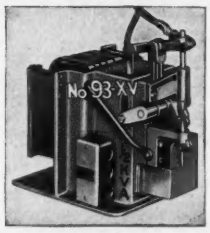
Machines to Handle
1/32" to 3/8" Rod
Round - Square - Flat - Hex
Ferrous and Non-Ferrous

Write For Bulletin

The Sign of Dependable Service:
WE CAN SUPPLY AND ENGINEER OUR TOOLS EQUIPPED WITH CARBOLOY CEMENTED CARBIDE

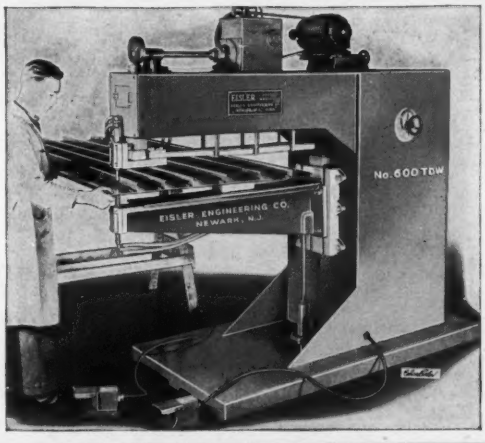
THE LEWIS MACHINE CO., 3440 E. 76 ST., CLEVE., O.

Bench Spot Welder
Foot Operated



We manufacture Electric Welders from 1/4 to 500 KVA. Special and Standard Types. WE MAKE A VERY LARGE VARIETY of Welders. Why not ask for more information or a catalog?

EISLER ENGINEERING CO.
760 S. 13th St. (Near Avon Ave.)
Newark, New Jersey



WIRE NAIL MACHINERY

These machines are made in eleven different sizes. This enables us to cover any size of nail most efficiently.

GLADER Nail making machines have been adopted as standard equipment in all recent major nail mill installations.

For further information, prices, etc., write to us.

Wm. Glader Machine Works
210 N. RACINE AVENUE, CHICAGO, ILL.

Learn about PARALAN

Paralan will give your finished wire and wire products protection from atmospheric corrosion in the mill and in shipping. Paralan-coated wire can be spot welded or soldered without cleaning. Also, Paralan leaves surfaces in good condition for all types of finishes—enameling, japanning, lacquering, plating, etc.

Write for further information. We may be able to solve your difficulties.

AMERICAN LANOLIN CORP.
LAWRENCE, MASSACHUSETTS

Buy **BUTT** **WIRE BRAIDING** *and* **CABLING MACHINES**

—Lower Production Costs
—Higher Production Standards
Write for Complete Information

NEW ENGLAND BUTT COMPANY
PROVIDENCE, R. I. CHICAGO, ILL.
European Agency: James Day (Machinery) Ltd.
Sentinel House, Southampton Row, London, W. C. 1 England

INVENTIONS — PATENTS

Interesting booklet, **General Information Concerning Inventions and Patents** and **Schedule of Government and Attorneys' Fees**, sent free on request. Simply ask for "booklet" and "fee schedule".

Lancaster, Allwine & Rommel
Registered Patent Attorneys
438 Bowen Bldg. Washington, D. C.

WRITE TODAY FOR OUR PRICES

Try WAYNE Wire Dies

Wire Drawing Diamond Dies

Wire dies by Wayne embody all the essentials necessary (quality stones — experienced workmanship — the most rigid of inspection) to assure accuracy plus long-life at high speed. Try Wayne dies today—see for yourself why drawers of wire acclaim *"Wayne the best die value obtainable."*

Wayne Wire Die Co., Inc. 57 SHERIDAN ST., IRVINGTON, NEW JERSEY

The Carbide Die — History, Manufacture and Use

(*Continued from Page 324*)

A SIMILAR problem occurs in the case of mandrels. Lubrication is more difficult. Carbide mandrels are in generally satisfactory use in the production of brass and copper and various alloy steel tubing, but in a more or less limited way for low carbon tubing.

✦ ✦ ✦

THE past five years have witnessed a fairly complete transition from the trade condition in which most dies were finished by the die manufacturer to that in which dies are supplied to the user in a rough or semifinished form. Such a change could occur only as a result of economic advantage to the user.

✦ ✦ ✦

THIS change, while almost complete so far as round hole dies are concerned is now just beginning to take place with shape dies.

✦ ✦ ✦

THE method of polishing holes in shape dies is distinct from round hole dies in that the lap needle does its work by a reciprocating motion instead of the rotary motion of round laps.

✦ ✦ ✦

ONE of the reasons that shape dies have not generally been made by the user is that machines for doing this work have not been generally available. This condition is now being changed and suitable machinery for making shape dies will soon be offered to the die user.

✦ ✦ ✦

THIS writer believes that from the same economic standpoint this change should also take place in the case of standard shapes which are essentially symmetrical and suggest the serious consideration of purchase of these shape dies in rough drilled form for mills in which any considerable numbers are used. It is hoped cored shape dies may be made available in the near future.

✦ ✦ ✦

IT is believed that the cost saving will result in the justifiable use of more carbide shaped dies

FOR DRY AND WET DRAWING

Wire Drawing Soaps

Successfully meet recent special demands made by high-speed drawing and the added attention given to brightness and finish.

FOR FERROUS, NON-FERROUS WIRE

MAGNUS CHEMICAL COMPANY 188 South Avenue, Garwood, N. J.

GEORGE D. HARTLEY

CONSULTANT
FOR THE
WIRE TRADES

311 MAIN STREET
WORCESTER, MASS.

KENNETH B. LEWIS
CONSULTING ENGINEER
Wire Mill Equipment, Layout and Practice
43 Midland St., Worcester, Mass.
Phone: Worcester 5-6033

HIGH SPEED

Welding Wire Straightening and Cutting Machinery
Round Wire Straightening and Cutting Machinery
Flat Wire Straightening and Cutting Machinery
Roll and Rotary Wire Straighteners

THE F. B. SHUSTER CO.
New Haven, Conn.
Straightener Specialists Since 1866

Wire Drawing Diamond Dies

COCHAUD
WIRE DIE CORPORATION
300 W. 56th St., NEW YORK
Tel. Col. 5-1340

than would be practical to purchase in finished form.

✦ ✦ ✦

NO story of carbide dies would be complete without mention of the early difficulty of introduction in the trade of these relatively high priced tools. It was only when the die manufacturer actually would give a guarantee that die costs with these expensive carbide dies would be less than with the steel and cast iron dies in use that the average mill would consent to give them a thorough trial.

✦ ✦ ✦

RESULTS are known—a fairly complete acceptance of the carbide die at present—wire of more uniform size and finish and wire drawing a standardized procedure no longer requiring the services of an artisan to maintain steady production.

✦ ✦ ✦

AND in conclusion some results in the industry which have come to the writer's notice:

Seventy five million pounds of finished copper and brass drawn with a carbide die investment of $14,000. Much output is yet to be had from these same dies.

✦ ✦ ✦

Twenty-seven million collapsible tin tubes produced with die still in good operation condition.

✦ ✦ ✦

One hundred thousand pounds of copper, per mil wear at .091 hole size, average production of dies of several manufacturers.

✦ ✦ ✦

Thirty-nine thousand tons of steel wire, including low and high carbon ranges from number five rod finished in sizes ranging to .045. Three hundred ninety-seven dies drafted with 3,188 holes. Total hole wear 8.179", averaging 9700# per mil wear. Run included the dies of several manufacturers. High carbon wire .060" diameter finish drawn at constantly increasing speeds.

✦ ✦ ✦

Three dies used in finishing spoke wire at .243" with tolerance ± .002" produced respectively: 2,386,200#
1,699,200#
1,898,900#

✦ ✦ ✦

The total finished size production of these three dies was 5,984,300 pounds, almost 3,000 tons.

CAROLINA CREST HOTEL

A Beachfront Hotel Just Off Beachfront

On Beautiful

North Carolina Ave., Atlantic City

Serving a

TRAY BREAKFAST

to your room any time up to 11 o'clock without any charge for breakfast or service.

EVERY ROOM HAS PRIVATE BATH

and at least three large windows

SINGLE AS LOW AS $2.50

DOUBLE AS LOW AS $5.00

HARRY L. FAIRBAIRN, Prop.
H. L. FAIRBAIRN, Jr., Mgr.

WHY NOT
GET YOUR WIRE DRAWING DIAMOND DIES FROM A SPECIALIST
CONSULT
RUSCH WIRE DIE CORPORATION
275 Seventh Ave., New York, N. Y.

A tubing die drawing low carbon steel tubing, original size .9375" produced 1,652,385 ft. with wear to .942". This was then recut to .999" and produced an additional 941,446 feet with wear to 1.005". It was again recut to 1.007" producing 1,628,612 additional feet, totalling 4,222,443 feet. Since this, over 7,000,000 more feet have been drawn with recuts. The total of these above figures is 11,222,443 feet, over 2100 miles.

✦ ✦ ✦

OTHER similar records are doubtless in the files of many mills.

This is an invitation for you to become a member of The Wire Association. ✦ ✦ ✦ ✦ ✦ ✦

The Annual Dues are $10.00

For Details Address

Richard E. Brown, Secretary
The Wire Association
Stamford Trust Co. Bldg.,
300 Main St., Stamford, Conn.

RUSCH WIRE DRAWING DIAMOND DIES
Have Improved Features to Give Increased Production
RUSCH WIRE DIE CORPORATION
275 Seventh Ave., New York, N. Y.

BRODEN
Wire Mill and Cold Rolling Equipment
Broden Construction Co.
11730 Harvard Ave.
CLEVELAND, OHIO

WIRE DRAWING MACHINERY AND EQUIPMENT
Rod Frames — 16" Frames, 8" Frames — Take-Up Frames, Wire Pointers—Puller Tongs.
General Castings for Wire Mill use.
Circulars on Request.
E. J. SCUDDER FOUNDRY & MACHINE CO.
TRENTON, N. J.

RUESCH
Machinery For
Wire, Tube, And Brass Mills
409 Mulberry St., Newark, N. J.

WIRE, WIRE ROPE AND ELECTRIC CABLE MACHINERY
THOMSON-JUDD WIRE MACHINERY COMPANY
SUBSIDIARY OF THOMSON-GIBB ELECTRIC WELDING COMPANY
LYNN, MASSACHUSETTS
WRITE FOR CATALOGUE

DIAMOND DIES CARBIDE
KELLY
WIRE DIE CORPORATION
19 W. 34th St. New York

WIRE MACHINERY SPECIALISTS
3—Nilson No. 1, 2, 3 & 4 4 Slide Wire Machines
2—Baird No. 3 & S3F 4 Slide Wire Machines
7—Waterbury Step Cone Wire Drawing Machines
1—Two Spindle Bull Block
8—Shuster Automatic S. & C. Machines 1/32", 3/16", 1/4", 5/16", 1/2", also 1/2", 3/8" square wire, motor driven.
Wanted: Wire Spring making machinery.
NATIONAL MACHINERY EXCHANGE
128-138 MOTT ST. NEW YORK, N. Y.

POSITION WANTED

Experienced superintendent and specialist in design and operating of rod rolling mills, both copper and steel. Fifteen years experience in Europe and South America; acquainted with latest improvements; capable of managing modern new or recondition plant. Knowledge of languages. References furnished.

Address Box 601,
WIRE & WIRE PRODUCTS

Visit of the Wire Association to The Norton Company

(*Continued from Page 345*)

ive grains. Two wheels of the same grain and grade, but differing in this grain spacing, will not grind alike.

✦ ✦ ✦

BECAUSE the grain spacing affects the grinding action of a wheel it is apparent that control of this characteristic is necessary if uniform results are to be obtained from wheel to wheel. **"Controlled Structure"** is the term used to designate positive control of grain spacing in Norton wheels and is an exclusive, patented Norton achievement.

Manufacturers of materials, tools and equipment for wire drawing and forming plants are constantly making improvements and additions to their lines. If you do not find the product or service in which you are interested, additional information will be supplied promptly. Simply address:
WIRE & WIRE PRODUCTS
300 Main St., Stamford, Conn.

Continuous Straightening and Cutting Machinery
With
FLYING SHEAR
for round and shaped wire.
✦ ✦ ✦
THE HALLDEN MACHINE COMPANY
THOMASTON CONNECTICUT

ZINC WIRE
THE PLATT BROS. & CO.
WATERBURY, CONN.

USE A TURKS HEAD
For Rectangular and Special Shaped Wire
STANDARD MACHINERY CO.
AUBURN, R. I.

ZINC WIRE
METAL WORKS, LTD.
SCHEIN BROTHERS
BEDZIN, POLAND

ROYLE PATERSON N J
BUILDING EXTRUDERS SINCE 1880
Pioneer builders of tubing and rubber covering machinery
JOHN ROYLE & SONS
PATERSON, N. J.
British Agency: James Day (Machinery) Ltd.
Sentinel House, Southampton Row,
London, W. C. 1, England

WIRE DRAWING SOAPS
THE VANCO COMPANY INC.
MANCHESTER, CONN.

All Sizes of
Twisted—Folded—Shaped Paper Insulation Twine
Also Slit Kraft
E. W. TWITCHELL, INCORPORATED
3rd & Somerset Sts., Phila., Pa.

MANUFACTURERS OF
WIRE BRAIDING — SPOOLING — TAPING
WINDING AND SPECIAL MACHINES
SINFRA WIRE COVERING MACHINES
FIDELITY MACHINE CO.
3908-18 Frankford Ave., Phila., Pa.

SC
Designers and Builders of Gas-Fired Heat Treating Furnaces for Ferrous and Non-Ferrous Wire.
SURFACE COMBUSTION CORPORATION
Main Plant and General Offices—Toledo, Ohio

Index to Advertisers

A

Aetna-Standard Engineering Co. 302
American Chemical Paint Co. 348
American Insulating Machinery Co. 347
American Lanolin Co. 350

B

Bethlehem Steel Corp. 299
Broden Construction Co. 352

C

Carl-Mayer Corp., The 347
Carboloy Company, Inc. 293
Carolina Crest Hotel 351
Cochaud Wire Die Corp. 351

D

Davis, R. L. Co. 338
Durant Mfg. Co. 346
Duriron Company, Inc., The 346

E

Eisler Engineering Co., Inc. 349
Electric Furnace Co., The ..... Back Cover

F

Farrel-Birmingham Co. 340
Fidelity Machine Co. 352
Firth Sterling Steel Co. 304

G

Glader, Wm., Machine Works 349

H

Hallden Machine Co., The 352
Hartley, Geo. D. 351
Hayward, R. B. Co. 348
Hudson Wire Company 300

K

Kelly Wire Die Corp. 352
Keystone Steel & Wire Co. 337

L

Lancaster, Allwine & Rommel 350
Lewis, K. B. 351
Lewis Machine Co., The 349

M

Magnus Chemical Co. 351
Micro Products Corp. 335
Morgan Construction Co. ..... Inside Back Cover
Mossberg Pressed Steel Corp. 339

N

National Machinery Exchange 352
New England Butt Co. 350
Norton Company 294

P

Pittsburgh Steel Company 295
Platt Brothers & Co. 352
Porter, H. K., Inc. 345

R

Republic Steel Corp. ..... Front Cover
Robertson, John, Co., Inc. 336
Royle, John, & Sons 352
Ruesch Machine Co., H. J. 352
Rusch Wire Die Corp. 351-352

S

Schein Bros. 352
Scott, H. L. Co. 343
Scudder Foundry & Machine Co., E. J. 352
Shuster, F. B. Co., The 351
Sleeper & Hartley, Inc. 318
Smit, J. K. & Sons, Inc. 349
Standard Machinery Co. 352
St. Joseph Lead Co. 301
Stevens Metal Products Co. 303
Surface Combustion Corp. 303
Syncro Machine Co., Div. of Elevator Supplies Co. 297

T

Thomson-Judd Wire Machinery Co. 352
Torrington Manufacturing Co., The 342
Twitchell, E. W., Inc. 352

V

Vanco Company, The 352
Vaughn Machinery Co., The ..... Inside Front Cover
Vianney Wire Die Works 348

W

Waterbury-Farrel F'dy. & Machine Co. 298
Watson Machine Co., The 341
Wayne Wire Die Co., Inc. 350

Bench Type Electric Spot Welding

SEVERAL new models of bench type electric spot welders have been brought out by the EISLER ENGINEERING COMPANY of South 13th Street, Newark, New Jersey. They range in sizes of ¼-½-1-2 and 3 KVA. The body which supports the mechanical parts and the transformer is fabricated from sheet iron and is a complete self-contained unit.

✦ ✦ ✦

THESE machines are made in two distinct models, as shown, namely, the Plunger-Press Type and the conventional Swinging-Arm Type. Many different combinations of electrode arrangements can be easily fitted into the electrode holders.

✦ ✦ ✦

BOTH types are arranged for 110 or 220 volts, and are made 25, 40, 50 or 60 cycle, A. C. single phase.

FOR various thicknesses within range, the heat requirements are regulated through a number of definite taps on the secondary. There are five secondary taps on each model that can be very rapidly changed for different heat requirements—the voltage on the secondary taps usually varies with the type of metal to be welded.

✦ ✦ ✦

IF the welding machines are mounted on a bench, a chain is extended to the floor to operate the welders with a foot treadle. They are also manufactured on individual stands when requirements call for such.

✦ ✦ ✦

THE speed of the welding machines depends entirely on the nature of the work and ranges anywhere from 25 to 150 spots per minute. They are employed for welding sheet metal and wire articles such as brass, bronze, iron, molybdenum, aluminum foil and many others.

✦ ✦ ✦

THESE bench welding machines are used extensively in the manufacturing of radio tubes, incandescent lamps, jewelry, optical frames, lampshades, cameras, novelties and fine metal goods which include silver and other precious metals. They are frequently employed for soldering jewelry, vanity and watch cases and small work such as pens, automatic pencils and smaller articles.

✦ ✦ ✦

THE weight of the 1 KVA size is approximately 45 lbs. These welders are very compact and indispensable where small, fine and rapid welding is required.

The Annual Convention of The Wire Association will be held at Chicago, Ill., October 23-27, 1939.

WHERE TO BUY

For more complete information, consult the annual Directory, Index & Buyers' Guide.

ABRASIVES—
Norton Co., Worcester, Mass.

ANNEALING POTS AND BOXES—
Scudder, E. J. Fdry. & Machine Co., Trenton, N. J.

ANTI-RUST—
Magnus Chemical Co., Garwood, N. J.

ARMORING EQUIPMENT—
American Insulating Mach'y. Co., Phila., Pa.
New England Butt Co., Providence, R. I.
Sleeper & Hartley, Inc., Worcester, Mass.
Syncro Machine Co., Rahway, N. J.
Watson Machine Co., Paterson, N. J.

BAKERS—Flash
Carl-Mayer Corp., The, Cleveland, Ohio.

BAKERS—Rod and Wire
Carl-Mayer Corp., The, Cleveland, Ohio.
Morgan Construction Co., Worcester, Mass.

BOBBINS—Braider and Wire Weaving
Mossberg Pressed Steel Corp., Attleboro, Mass.

BORON CARBIDE—
Norton Co., Worcester, Mass.

BORTZ—Diamond
Smit, J. K. & Sons, Inc., New York, N. Y.

CARRIERS—Braider, High Speed
Mossberg Pressed Steel Corp., Attleboro, Mass.

CEMENT FLOOR CLEANER—
Magnus Chemical Co., Garwood, N. J.

CEMENTS—Refractory
Norton Co., Worcester, Mass.

CHEMICALS—Cleaning
American Chemical Paint Co., Ambler, Pa.
Magnus Chemical Co., Garwood, N. J.

CLEANERS—Hand and Metal
Magnus Chemical Co., Garwood, N. J.

CLEANING & PICKLING EQUIPMENT—
Broden Construction Co., Cleveland, O.
Duriron Co., The, Dayton, O.
Morgan Construction Co., Worcester, Mass.
Vaughn Machinery Co., Cuyahoga Falls, O.

CLIPPERS & CUTTERS—
Potter, H. K., Inc., Everett, Mass.

CLOTH TESTERS—
Scott, Henry L., Co., Providence, R. I.

COATING—Protective
American Lanolin Corp., Lawrence, Mass.

COILERS—Sheet, Strip and Wire
Broden Construction Co., Cleveland, O.
H. J. Ruesch Machine Co., Newark, N. J.
Torrington Mfg. Co., The, Torrington, Conn.

COPHOLDERS—Steel
Mossberg Pressed Steel Corp., Attleboro, Mass.

CRANES—Wire Mill
Morgan Construction Co., Worcester, Mass.
Vaughn Machinery Co., Cuyahoga Falls, O.

DIAMOND POWDERS—
Smit, J. K. & Sons, Inc., New York, N. Y.

DIAMOND TOOLS—
Rusch Wire Die Corp., New York, N. Y.

DIES—Diamond
Cochaud Wire Die Co., New York, N. Y.
Kelly Wire Die Corp., New York, N. Y.
Rusch Wire Die Corp., New York, N. Y.
Vianney Wire Die Works, New York, N. Y.
Wayne Wire Die Co., Irvington, N. J.

DIES—Lead Extrusion
John Robertson Co., Brooklyn, N. Y.

DIES—Repairs & Re-Cutting
Carboloy Co., Inc., Detroit, Mich.
Cochaud Wire Die Co., New York, N. Y.
Firth-Sterling Steel Co., McKeesport, Pa.
Kelly Wire Die Corp., New York, N. Y.
Rusch Wire Die Corp., New York, N. Y.
Vianney Wire Die Works, New York, N. Y.
Wayne Wire Die Co., Inc., Irvington, N. J.

DIES—Rod and Tube Drawing
Carboloy Co., Inc., Detroit, Mich.
Firth-Sterling Steel Co., McKeesport, Pa.
Kelly Wire Die Corp., New York, N. Y.
Rusch Wire Die Corp., New York, N. Y.
Vianney Wire Die Works, New York, N. Y.

DIES—Tantalum Carbide
Carboloy Co., Inc., Detroit, Mich.
Firth-Sterling Steel Co., McKeesport, Pa.
Kelly Wire Die Corp., New York, N. Y.
Rusch Wire Die Corp., New York, N. Y.
Vianney Wire Die Works, New York, N. Y.

DIES—Tungsten Carbide
Carboloy Co., Inc., Detroit, Mich.
Firth-Sterling Steel Co., McKeesport, Pa.
Kelly Wire Die Corp., New York, N. Y.
Rusch Wire Die Corp., New York, N. Y.
Vianney Wire Die Works, New York, N. Y.

DRAW BENCHES—
H. J. Ruesch Machine Co., Newark, N. J.
Scudder, E. J., Fdry. & Machine Co., Trenton, N. J.
Vaughn Machinery Co., Cuyahoga Falls, O.

DRUMS—Flange Steel
Stevens Metal Products Co., Niles, O.

DRUMS—Vulcanizing
Mossberg Pressed Steel Corp., Attleboro, Mass.

ENGINEERS—Consulting Wire Mill
Hartley, George D., Worcester, Mass.
Lewis, Kenneth B., New York, N. Y.

EYELETS—Brass or Zinc
Platt Bros. & Co., The, Waterbury, Conn.

FILLERS—Paper for Cable
E. W. Twitchell, Inc., Phila., Pa.

FLASH BAKER—
Carl-Mayer Corp., The, Cleveland, Ohio.

FURNACES—Annealing
Electric Furnace Co., Salem, O.
Surface Combustion Corp., Toledo, Ohio.

FURNACES—Automatic
Electric Furnace Co., Salem, O.
Surface Combustion Corp., Toledo, Ohio.

FURNACES—Brazing
Firth-Sterling Steel Co., McKeesport, Pa.

FURNACES—Bright Annealing
Electric Furnace Co., Salem, O.
Surface Combustion Corp., Toledo, Ohio.

FURNACES—Electric
Electric Furnace Co., Salem, O.
Surface Combustion Corp., Toledo, Ohio.

FURNACES—Hardening and Tempering
Electric Furnace Co., Salem, O.
Surface Combustion Corp., Toledo, Ohio.

FURNACES—Lead Melting
Electric Furnace Co., Salem, O.
John Robertson Co., Brooklyn, N. Y.
Surface Combustion Corp., Toledo, Ohio.

FURNACES—Non-Oxidizing
Electric Furnace Co., Salem, O.
Surface Combustion Corp., Toledo, Ohio.

FURNACES—Normalizing
Electric Furnace Co., Salem, O.
Surface Combustion Corp., Toledo, Ohio.

FURNACES—Salt Bath
Electric Furnace Co., Salem, O.
Surface Combustion Corp., Toledo, Ohio.

FURNACES—Wire, Strip & Sheet
Electric Furnace Co., Salem, O.
Surface Combustion Corp., Toledo, Ohio.

GRINDERS—Roll
Farrel-Birmingham Co., Ansonia, Conn.
Norton Co., Worcester, Mass.

INHIBITORS—
American Chemical Paint Co., Ambler, Pa.

INSULATION — Cable or Cable Filler
E. W. Twitchell, Inc., Phila., Pa.

LATHES—Die Reaming
Morgan Construction Co., Worcester, Mass.
Vaughn Machinery Co., Cuyahoga Falls, O.

LEAD—Pig
St. Joseph Lead Co., Josephtown, Beaver County, Pa.

LUBRICANTS—For Metal Cutting, Stamping and Drawing
Magnus Chemical Co., Garwood, N. J.
Vanco, Co., The, Manchester, Conn.

LUBRICANTS—Wire Drawing
Magnus Chemical Co., Garwood, N. J.
Vanco, Co., The, Manchester, Conn.

MACHINERY — Armoring (Cable, Wire Hose)
American Insulating Mach'y. Co., Phila., Pa.
New England Butt Co., Providence, R. I.
John Robertson Co., Brooklyn, N. Y.
Sleeper & Hartley, Inc., Worcester, Mass.
Syncro Machine Co., Rahway, N. J.
Thomson-Judd Wire Machinery Co., Lynn, Mass.
Torrington Mfg. Co., The, Torrington, Conn.
Watson Machine Co., Paterson, N. J.

MACHINERY—Braiding
Fidelity Machine Co., Philadelphia, Pa.
New England Butt Co., Providence, R. I.
Watson Machine Co., Paterson, N. J.

MACHINERY—Brazing
Thomson-Judd Wire Machinery Co., Lynn, Mass.

MACHINERY—Bunching
American Insulating Mach'y. Co., Phila., Pa.
New England Butt Co., Providence, R. I.
Sleeper & Hartley, Inc., Worcester, Mass.
Syncro Machine Co., Rahway, N. J.
Watson Machine Co., Paterson, N. J.

MACHINERY—Bundling, Scrap
Sleeper & Hartley, Inc., Worcester, Mass.
Vaughn Machinery Co., Cuyahoga Falls, O.
Watson Machine Co., Paterson, N. J.

MACHINERY—Cable, Electric
American Insulating Mach'y. Co., Phila., Pa.
Fidelity Machine Co., Philadelphia, Pa.
New England Butt Co., Providence, R. I.
Syncro Machine Co., Rahway, N. J.
Thompson-Gibb Electric Welding Co., Lynn, Mass.
Torrington Mfg. Co., The, Torrington, Conn.
Watson Machine Co., Paterson, N. J.

MACHINERY—Chain Making
Vaughn Machinery Co., Cuyahoga Falls, O.

MACHINERY—Closing
New England Butt Co., Providence, R. I.
Torrington Mfg. Co., The, Torrington, Conn.
Watson Machine Co., Paterson, N. J.

WHERE TO BUY, Continued

MACHINERY—Coil Winding

Sleeper & Hartley, Inc., Worcester, Mass.
Syncro Machine Co., Rahway, N. J.
Torrington Mfg. Co., The, Torrington, Conn.

MACHINERY—Coilers

Broden Construction Co., Cleveland, O.
Morgan Construction Co., Worcester, Mass.
New England Butt Co., Providence, R. I.
H. J. Ruesch Machine Co., Newark, N. J.
Sleeper & Hartley, Inc., Worcester, Mass.
Syncro Machine Co., Rahway, N. J.
Torrington Mfg. Co., The, Torrington, Conn.
Waterbury-Farrel Fdry. & Machine Co., Waterbury, Conn.
Watson Machine Co., Paterson, N. J.

MACHINERY—Copper Wire Drawing and Rolling

Farrel-Birmingham Co., Ansonia, Conn.
H. J. Ruesch Machine Co., Newark, N. J.
Syncro Machine Co., Rahway, N. J.
Torrington Mfg. Co., The, Torrington, Conn.
Vaughn Machinery Co., Cuyahoga Falls, O.
Waterbury-Farrel Fdry. & Machine Co., Waterbury, Conn.

MACHINERY—Covering Wire

Fidelity Machine Co., Philadelphia, Pa.
Syncro Machine Co., Rahway, N. J.

MACHINERY—Cutting

Broden Construction Co., Cleveland, O.
Farrel-Birmingham Co., Ansonia, Conn.
Hallden Machine Co., Thomaston, Conn.
Lewis Machine Co., The, Cleveland, O.
National Machinery Exchange (Used), New York, N. Y.
F. B. Shuster Co., New Haven, Conn.
Sleeper & Hartley, Inc., Worcester, Mass.
Syncro Machine Co., Rahway, N. J.

MACHINERY—Die Making

Firth-Sterling Steel Co., McKeesport, Pa.

MACHINERY—Enameling

American Insulating Mach'y. Co., Phila., Pa.
Syncro Machine, Rahway, N. J.

MACHINERY—Extruding

John Robertson Co., Brooklyn, N. Y.
Royle, John & Sons, Paterson, N. J.
Watson Machine Co., Paterson, N. J.

MACHINERY—Flat Wire

Broden Construction Co., Cleveland, O.
H. J. Ruesch Machine Co., Newark, N. J.
Sleeper & Hartley, Inc., Worcester, Mass.
Torrington Mfg. Co., The, Torrington, Conn.

MACHINERY—Forming

National Machinery Exchange (Used), New York, N. Y.
Sleeper & Hartley, Inc., Worcester, Mass.
Torrington Mfg. Co., The, Torrington, Conn.

MACHINERY—Galvanizing Wire

Broden Construction Co., Cleveland, O.
Sleeper & Hartley, Inc., Worcester, Mass.
Vaughn Machinery Co., Cuyahoga Falls, O.

MACHINERY—Gang Winders

Fidelity Machine Co., Philadelphia, Pa.
H. J. Ruesch Machine Co., Newark, N. J.
Syncro Machine Co., Rahway, N. J.
Watson Machine Co., Paterson, N. J.

MACHINERY—Grinding

Norton Co., Worcester, Mass.

MACHINERY—Insulating

American Insulating Mach'y. Co., Phila., Pa.
Fidelity Machine Co., Philadelphia, Pa.
New England Butt Co., Providence, R. I.
Syncro Machine Co., Rahway, N. J.
Watson Machine Co., Paterson, N. J.

MACHINERY—Knitting

Fidelity Machine Co., Philadelphia, Pa.

MACHINERY—Lead Encasing Presses, etc.

John Robertson Co., Brooklyn, N. Y.

MACHINERY—Lead Stripping

John Robertson Co., Brooklyn, N. Y.
Watson Machine Co., Paterson, N. J.

MACHINERY—Lock Washer

Sleeper & Hartley, Inc., Worcester, Mass.
Torrington Mfg. Co., The, Torrington, Conn.

MACHINERY—Magnet Wire

American Insulating Mach'y. Co., Phila., Pa.
New England Butt Co., Providence, R. I.
Sleeper & Hartley, Inc., Worcester, Mass.
Syncro Machine Co., Rahway, N. J.
Torrington Mfg. Co., The, Torrington, Conn.

MACHINERY — Measuring Wire & Cable

Davis, R. L., Electric Corp., Wallingford, Conn.
Durant Mfg. Co., Milwaukee, Wis.
New England Butt Co., Providence, R. I.
Watson Machine Co., Paterson, N. J.

MACHINERY—Nail and Tack

Glader, Wm., Machine Works Co., Chicago, Ill.
National Machinery Exchange (Used), New York, N. Y.
Sleeper & Hartley, Inc., Worcester, Mass.

MACHINERY—Panning

American Insulating Mach'y. Co., Phila., Pa.
Syncro Machine Co., Rahway, N. J.

MACHINERY—Pointing

Broden Construction Co., Cleveland, O.
H. J. Ruesch Machine Co., Newark, N. J.
Scudder, E. J., Fdry. & Machine Co., Trenton, N. J.
Sleeper & Hartley, Inc., Worcester, Mass.
Syncro Machine Co., Rahway, N. J.
Torrington Mfg. Co., The, Torrington, Conn.
Vaughn Machinery Co., Cuyahoga Falls, O.
Waterbury-Farrel Fdry. & Machine Co., Waterbury, Conn.

MACHINERY—Rod Mill

Broden Construction Co., Cleveland, O.
Morgan Construction Co., Worcester, Mass.
H. J. Ruesch Machine Co., Newark, N. J.

MACHINERY—Rolling Mill

Broden Construction Co., Cleveland, O.
Farrel-Birmingham Co., Ansonia, Conn.
Morgan Construction Co., Worcester, Mass.
National Machinery Exchange (Used), New York, N. Y.
H. J. Ruesch Machine Co., Newark, N. J.
Syncro Machine, Rahway, N. J.
Torrington Mfg. Co., The, Torrington, Conn.
Waterbury-Farrel Fdry. & Machine Co., Waterbury, Conn.

MACHINERY—Rubber Strip Covering

Farrel-Birmingham Co., Ansonia, Conn.
New England Butt Co., Providence, R. I.
Watson Machine Co., Paterson, N. J.

MACHINERY—Rubber Tubing and Straining

Royle, John, & Sons, Paterson, N. J.
Sleeper & Hartley, Inc., Worcester, Mass.
Torrington Mfg. Co., The, Torrington, Conn.
Watson Machine Co., Paterson, N. J.

MACHINERY—Screw Wire

National Machinery Exchange (Used), New York, N. Y.
Sleeper & Hartley, Worcester, Mass.

MACHINERY—Special

American Insulating Mach'y. Co., Phila., Pa.
Broden Construction Co., Cleveland, O.
New England Butt Co., Providence, R. I.
H. J. Ruesch Machine Co., Newark, N. J.
Scudder, E. J., Fdry. & Machine Co., Trenton, N. J.
Sleeper & Hartley, Inc., Worcester, Mass.
Syncro Machine Co., Rahway, N. J.
Torrington Mfg. Co., The, Torrington, Conn.
Watson Machine Co., Paterson, N. J.

MACHINERY—Spooling

American Insulating Mach'y. Co., Phila., Pa.
Fidelity Machine Co., Philadelphia, Pa.
New England Butt Co., Providence, R. I.
Sleeper & Hartley, Inc., Worcester, Mass.
Syncro Machine Co., Rahway, N. J.
Torrington Mfg. Co., The, Torrington, Conn.
Vaughn Machinery Co., Cuyahoga Falls, O.
Watson Machine Co., Paterson, N. J.

MACHINERY—Spring Making

National Machinery Exchange (Used), New York, N. Y.
Sleeper & Hartley, Inc., Worcester, Mass.
Torrington Mfg. Co., The, Torrington, Conn.

MACHINERY—Staple

Sleeper & Hartley, Inc., Worcester, Mass.

MACHINERY—Straightening

Broden Construction Co., Cleveland, O.
Haliden Machine Co., Thomaston, Conn.
Lewis Machine Co., The, Cleveland, O.
National Machinery Exchange (Used), New York, N. Y.
H. J. Ruesch Machine Co., Newark, N. J.
F. B. Shuster, New Haven, Conn.
Sleeper & Hartley, Inc., Worcester, Mass.
Torrington Mfg. Co., The, Torrington, Conn.

MACHINERY—Stranding

Sleeper & Hartley, Inc., Worcester, Mass.
Thomson-Judd Wire Machinery Co., Lynn, Mass.
Torrington Mfg. Co., The, Torrington, Conn.
Watson Machine Co., Paterson, N. J.

MACHINERY—Strip Steel

Broden Construction Co., Cleveland, O.
H. J. Ruesch Machine Co., Newark, N. J.
Torrington Mfg. Co., The, Torrington, Conn.

MACHINERY—Swaging

National Machinery Exchange (Used), New York, N. Y.
H. J. Ruesch Machine Co., Newark, N. J.
Sleeper & Hartley, Inc., Worcester, Mass.
Syncro Machine, Rahway, N. J.
Torrington Mfg. Co., The, Torrington, Conn.
Waterbury-Farrel Fdry. & Machine Co., Waterbury, Conn.

MACHINERY—Taping

American Insulating Mach'y. Co., Phila., Pa.
Fidelity Machine Co., Philadelphia, Pa.
New England Butt Co., Providence, R. I.
Syncro Machine Co., Rahway, N. J.
Thomson-Judd Wire Machinery Co., Lynn, Mass.
Torrington Mfg. Co., The, Torrington, Conn.
Watson Machine Co., Paterson, N. J.

MACHINERY—Testing

Scott, Henry L., Co., Providence, R. I.

MACHINERY—Testing Size of Wire

Torrington Mfg. Co., The, Torrington, Conn.

MACHINERY—Tinsel Rolling Mills

American Insulating Mach'y. Co., Phila., Pa.
Syncro Machine, Rahway, N. J.

MACHINERY—Trolley Wire

Vaughn Machinery Co., Cuyahoga Falls, O.

MACHINERY—Tube Mill

H. J. Ruesch Machine Co., Newark, N. J.
Torrington Mfg. Co., The, Torrington, Conn.

MACHINERY—Welding Wire

Eisler Engineering Co., Inc., Newark, N. J.
Micro Products Co., Chicago, Ill.
F. B. Shuster Co., New Haven, Conn.
Thomson-Judd Wire Machinery Co., Lynn, Mass.

MACHINERY—Winding

American Insulating Mach'y. Co., Phila., Pa.
Fidelity Machine Co., Philadelphia, Pa.
New England Butt Co., Providence, R. I.
Sleeper & Hartley, Inc., Worcester, Mass.
Syncro Machine Co., Rahway, N. J.
Torrington Mfg. Co., The, Torrington, Conn.
Watson Machine Co., Paterson, N. J.

MACHINERY—Wire Drawing

Aetna-Standard Engineering Co., Youngstown, O.
American Insulating Mach'y. Co., Phila., Pa.
Broden Construction Co., Cleveland, O.
Morgan Construction Co., Worcester, Mass.
National Machinery Exchange (Used), New York, N. Y.
H. J. Ruesch Machine Co., Newark, N. J.
Scudder, E. J., Fdry. & Machine Co., Trenton, N. J.
Sleeper & Hartley, Inc., Worcester, Mass.
Syncro Machine Co., Rahway, N. J.
Thomson-Judd Wire Machinery Co., Lynn, Mass.
Torrington Mfg. Co., The, Torrington, Conn.
Vaughn Machinery Co., Cuyahoga Falls, O.
Waterbury-Farrel Fdry. & Machine Co., Waterbury, Conn.

WHERE TO BUY, Continued

MACHINERY—Wire Measuring
Durant Mfg. Co., Milwaukee, Wis.

MACHINERY—Wire Rope
New England Butt Co., Providence, R. I.
Thomson-Judd Wire Machinery Co., Lynn, Mass.
Watson Machine Co., Paterson, N. J.

MACHINERY—Wire Tinning
American Insulating Mach'y. Co., Phila., Pa.
New England Butt Co., Providence, R. I.
Syncro Machine Co., Rahway, N. J.

MACHINERY—Wood Screw
National Machinery Exchange (Used), New York, N. Y.

MILLS—Tandem Rolling and Edging
Torrington Mfg. Co., The, Torrington, Conn.

NICKEL SILVER AND PHOSPHOR BRONZE—Rod, Wire and Strip
Hudson Wire Co., Ossining, N. Y.

PANS—Vulcanizing
Mossberg Pressed Steel Corp., Attleboro, Mass.

PAPER—Insulating
E. W. Twitchell, Inc., Phila., Pa.

PAPER TESTERS—
Scott, Henry L., Co., Providence, R. I.

PATENT ATTORNEYS—
Lancaster, Allwine and Rommel, Washington, D. C.

PICKLING COMPOUNDS—
American Chemical Paint Co., Ambler, Pa.

PIPING AND FITTINGS—Acid Resistant
Duriron Co., Inc., The, Dayton, O.

PLASTIC TESTERS—
Scott, Henry L., Co., Providence, R. I.

POTS—Lead Melting
John Robertson Co., Brooklyn, N. Y.

PRESSES—Hydraulic and Mechanical
John Robertson Co., Brooklyn, N. Y.

PRESSES—Lead
John Robertson Co., Brooklyn, N. Y.

PULLERS—Wire
Scudder, E. J., Fdry. & Machine Co., Trenton, N. J.
Sleeper & Hartley, Inc., Worcester, Mass.

PUMPS—Hydraulic
John Robertson Co., Brooklyn, N. Y.

REEL AND TENSION STAND—
Fidelity Machine Co., Philadelphia, Pa.
Sleeper & Hartley, Inc., Worcester, Mass.
Syncro Machine Co., Rahway, N. J.
Torrington Mfg. Co., The, Torrington, Conn.

REEL CRUTCHES—
Watson Machine Co., Paterson, N. J.

REELS—Annealing and Stranding
Hayward, R. B. Co., Chicago, Ill.
Mossberg Pressed Steel Corp., Attleboro, Mass.
Stevens Metal Products Co., Niles, O.

REELS—Steel
Hayward, R. B. Co., Chicago, Ill.
Mossberg Pressed Steel Corp., Attleboro, Mass.
Stevens Metal Products Co., Niles, O.

REELS—Takeoff
Mossberg Pressed Steel Corp., Attleboro, Mass.

REELS AND SPOOLS—Shipping and Shop
Hayward, R. B. Co., Chicago, Ill.
Mossberg Pressed Steel Corp., Attleboro, Mass.
Stevens Metal Products Co., Niles, O.

REELS—Vulcanizing and Impregnating
Hayward, R. B. Co., Chicago, Ill.
Mossberg Pressed Steel Corp., Attleboro, Mass.
Stevens Metal Products Co., Niles, O.

REELS—Wire Drawing
Hayward, R. B. Co., Chicago, Ill.
Mossberg Pressed Steel Corp., Attleboro, Mass.
Stevens Metal Products Co., Niles, O.

REFRACTORIES—High Temperature
Norton Co., Worcester, Mass.

ROD BAKERS—
Carl-Mayer Corp., The, Cleveland, Ohio.

RODS—Wire—Non-Ferrous
Hudson Wire Co., Ossining, N. Y.
Platt Bros. & Co., The, Waterbury, Conn.

RODS—Wire—Steel
Bethlehem Steel Co., Bethlehem, Pa.
Keystone Steel & Wire Co., Peoria, Ill.
Pittsburgh Steel Co., Pittsburgh, Pa.
Republic Steel Corp., Cleveland, O.

RUBBER AND RUBBER COMPRESSION TESTERS—
Scott, Henry L., Co., Providence, R. I.

ROLLS—
Farrel-Birmingham Co., Ansonia, Conn.

RUST PROOF COMPOUND—
American Lanolin Co., Lawrence, Mass.

SHEET—Steel
Continental Steel Corp., Kokomo, Ind.

SKIN PROTECTOR—
Magnus Chemical Co., Garwood, N. J.

SOAPS—Industrial and Wire Drawing
Magnus Chemical Co., Garwood, N. J.
Vanco, Co., The, Manchester, Conn.

SPOOLS—Annealing and Wire Drawing
Mossberg Pressed Steel Corp., Attleboro, Mass.
Stevens Metal Products Co., Niles, O.

SPOOLS—Shipping and Shop
Hayward, R. B. Co., Chicago, Ill.
Mossberg Pressed Steel Corp., Attleboro, Mass.
Stevens Metal Products Co., Niles, O.

SPOOLS—Steel
Hayward, R. B. Co., Chicago, Ill.
Mossberg Pressed Steel Corp., Attleboro, Mass.
Stevens Metal Products Co., Niles, O.

STAMPINGS—Steel
Mossberg Pressed Steel Corp., Attleboro, Mass.

STRIP—Brass and Non Ferrous
Hudson Wire Co., Ossining, N. Y.

STRIP—Steel
Firth-Sterling Steel Co., McKeesport, Pa.
Pittsburgh Steel Co., Pittsburgh, Pa.
Republic Steel Corp., Cleveland, O.

STRIP METAL TESTERS—
Scott, Henry L., Co., Providence, R. I.

SWIFTS—Take-off
Mossberg Pressed Steel Corp., Attleboro, Mass.

TANKS—Compound
Watson Machine Co., Paterson, N. J.

TANKS—Steel
Mossberg Pressed Steel Corp., Attleboro, Mass.

TENSILE TESTERS—
Scott, Henry L., Co., Providence, R. I.

TOOLS—Wire Cutting
Porter, H. K., Inc,. Everett, Mass.

TREADS—Safety
Norton Co., Worcester, Mass.

TRUCKS—
Morgan Construction Co., Worcester, Mass.
Vaughn Machinery Co., Cuyahoga Falls, O.

TUBE BENDERS AND FORMERS—
H. J. Ruesch Machine Co., Newark, N. J.

TURKS HEAD—
Standard Machinery Co., Auburn, R. I.

VALVES AND FITTINGS—Acid Proof
Duriron Co., The, Dayton, O.

VULCANIZERS—
Watson Machine Co., Paterson, N. J.

VULCANIZING PANS—
American Insulating Mach'y. Co., Phila., Pa.

WELDERS—Spot and Butt
Eisler Engineering Co., Newark, N. J.

WIRE—Cold Heading
Bethlehem Steel Co., Bethlehem, Pa.
Keystone Steel & Wire Co., Peoria, Ill.
Pittsburgh Steel Co., Pittsburgh, Pa.
Republic Steel Corp., Cleveland, O.

WIRE—Electric
Hudson Wire Co., Ossining, N. Y.

WIRE—Enameled For Coils
Winsted Div. of Hudson Wire Co., Winsted, Conn.

WIRE—Manufacturers
Bethlehem Steel Co., Bethlehem, Pa.
Firth-Sterling Steel Co., McKeesport, Pa.
Keystone Steel & Wire Co., Peoria, Ill.
Pittsburgh Steel Co., Pittsburgh, Pa.
Republic Steel Corp., Cleveland, O.

WIRE—Nickel Silver and Phosphor Bronze
Hudson Wire Co., Ossining, N. Y.

WIRE—Non Ferrous to Specification For Special Purposes
Hudson Wire Co., Ossining, N. Y.
Winsted Div. of Hudson Wire Co., Winsted, Conn.

WIRE—Spring
Bethlehem Steel Co., Bethlehem, Pa.
Firth-Sterling Steel Co., McKeesport, Pa.
Keystone Steel & Wire Co., Peoria, Ill.
Pittsburgh Steel Co., Pittsburgh, Pa.

WIRE—Stainless Steel—
Firth-Sterling Steel Co., McKeesport, Pa.

WIRE—Steel—Also Coppered Steel—Also Galvanized Steel
Bethlehem Steel Co., Bethlehem, Pa.
Keystone Steel & Wire Co., Peoria, Ill.
Pittsburgh Steel Co., Pittsburgh, Pa.
Republic Steel Corp., Cleveland, O.

WIRE TESTERS—
Scott, Henry L., Providence, R. I.

WIRE AND STRIP—Zinc
Metal Industry Works, Poland.
Platt Bros. & Co., The, Waterbury, Conn.

YARN TESTERS—
Scott, Henry L., Co., Providence, R. I.

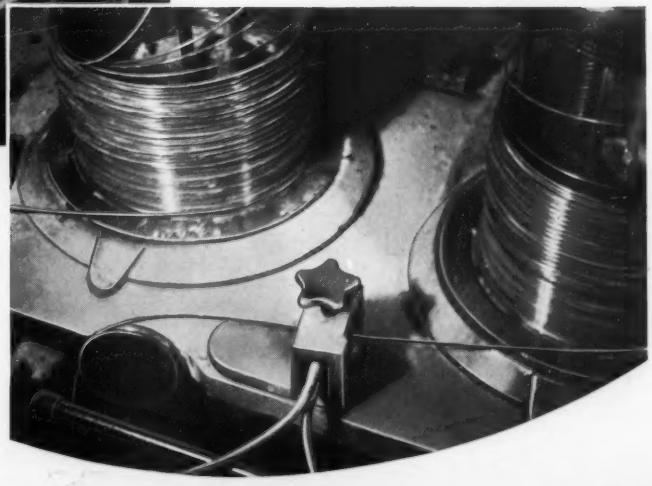
ZINC—Slab
St. Joseph Lead Co., Josephtown, Beaver County, Pa.

THE Metallurgist LOOKS AT QUALITY

Without dependable equipment in the wire mill, the metallurgist's skill and experience in setting up correct specifications goes for nothing. That's why so many technicians rely on Morgan-Connor Continuous Wire Drawing Machines to "deliver the goods"—as specified. These machines are √flexible, readily adapted to drawing various types of wire at high speed with √accuracy. Their high blocks permit ample storage between dies and their unique air cooling system √controls temperatures. Even before the finished wire is inspected and tested, the metallurgist is confident that Morgan design and accuracy have again come through on √quality.

Continuous Wire Drawing Machines; Take-up Frames; Horizontal Bull Blocks; Vertical Spindle Bull Blocks; Reels; Pointers; Motor Drives; Wire Mill Accessories.

MORGAN
WORCESTER
ENGINEERS AND
MANUFACTURERS

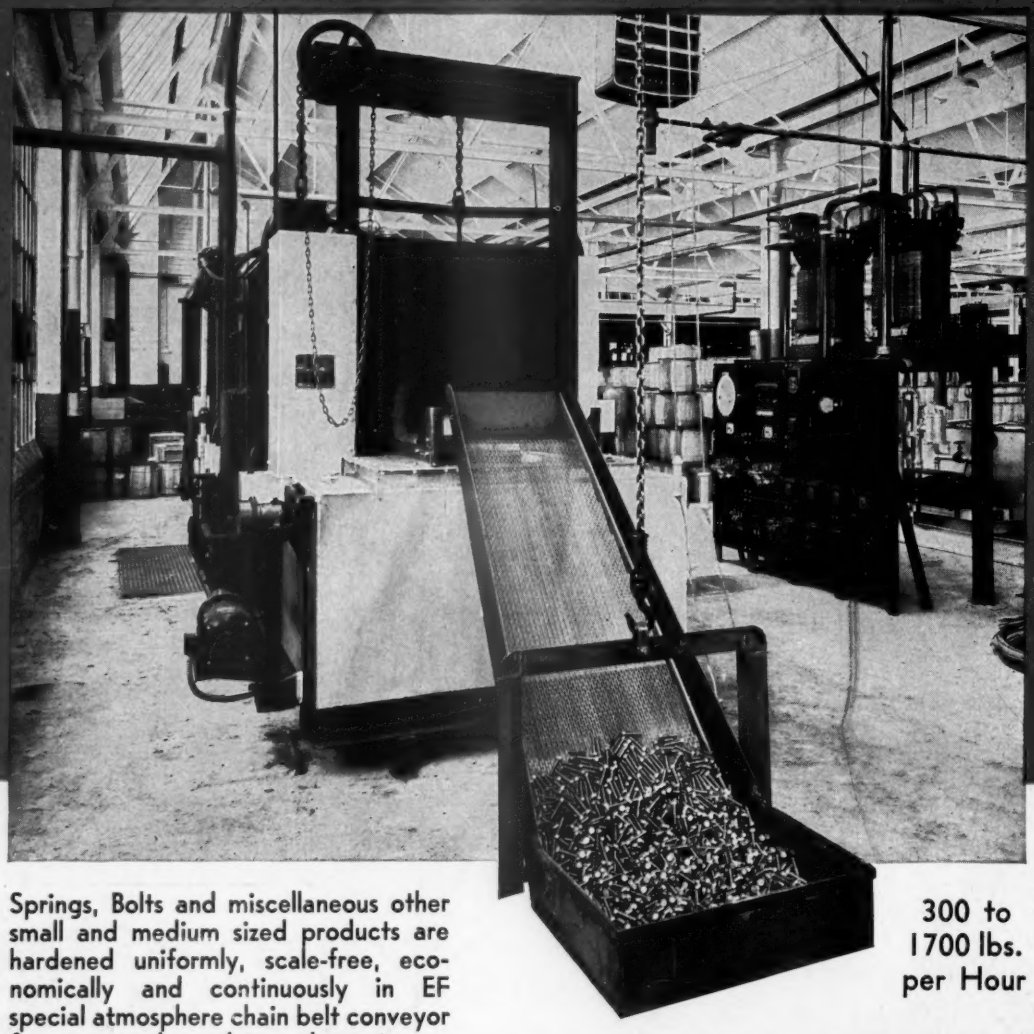


MORGAN CONSTRUCTION CO.
WORCESTER, MASSACHUSETTS, U. S. A.
Sole European Representatives:
MALMEDIE & CO., Dusseldorf, Germany

W38

MORGAN Wire Drawing Machinery

For Scale Free Hardening



Springs, Bolts and miscellaneous other small and medium sized products are hardened uniformly, scale-free, economically and continuously in EF special atmosphere chain belt conveyor furnaces, such as shown above.

Built in five standard sizes with capacities ranging from 300 to 1700 lbs. per hour.

Equipped with EF recuperative type gas fired radiant tubes or electrically heated.

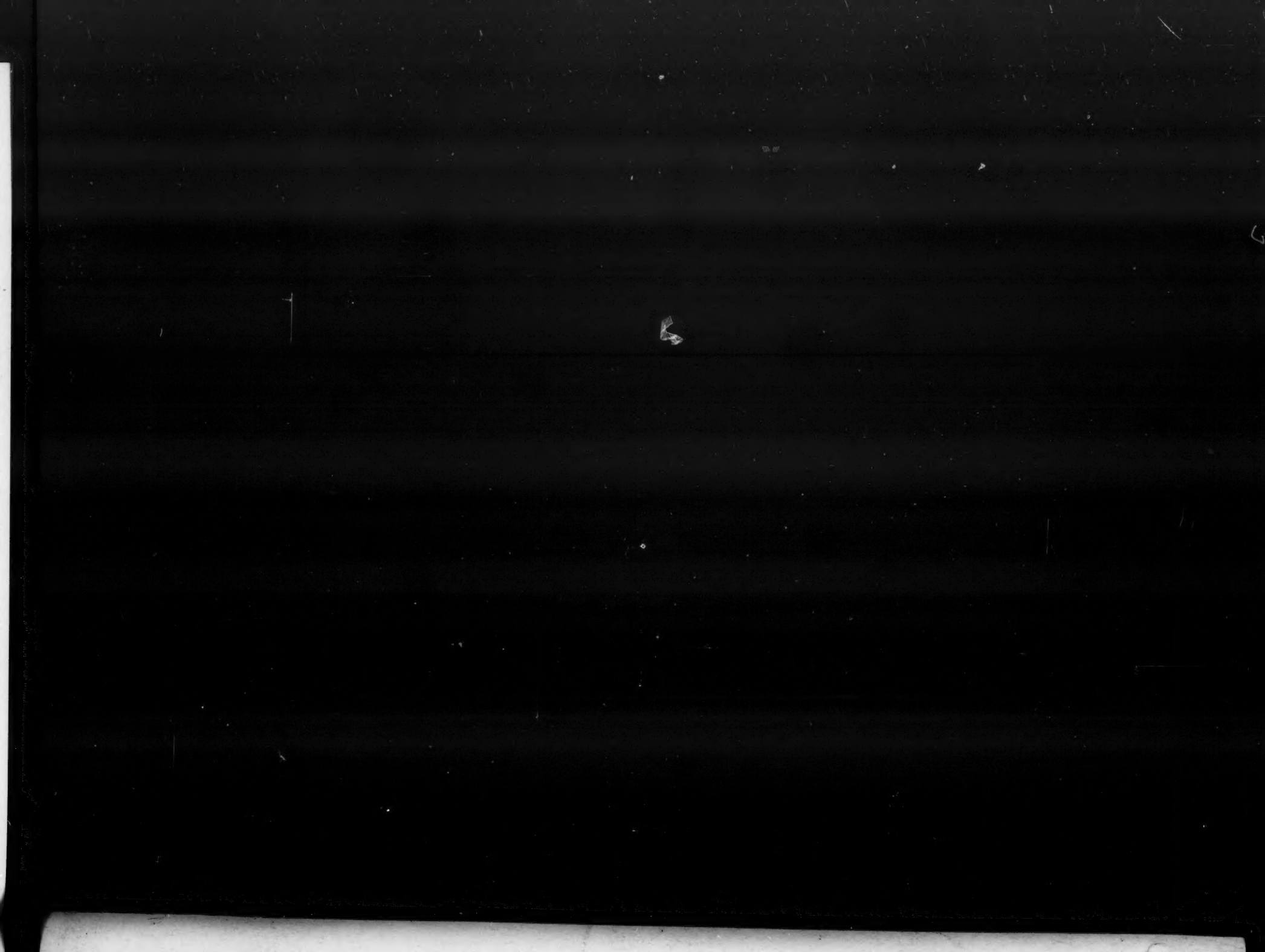
We will be glad to give you complete information, including installation and operating costs and show you clean hardened samples, if interested.

Send for leaflets showing interesting installations.

300 to 1700 lbs. per Hour

Other EF controlled atmosphere installations include furnaces for bright and clean annealing various ferrous and non ferrous products including wire, tubing, strip, sheet, stampings and other products — furnaces for copper brazing, scale-free heat treating and annealing without scale or decarburization, as well as furnaces of various types for normalizing, short cycle malleableizing, nitriding, carburizing, billet heating, heating for forging, enameling and other processes.

Submit your furnace problems to EF engineers.

The Electric Furnace Co., Salem, Ohio

Gas Fired, Oil Fired and Electric Furnaces---For Any Process, Product or Production